Land Clearance
and Utilisation

WORLD CROPS

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More time to kill

Down the Ems, the barges swing on the current, diesel chugging or black smoking towards the North Sea. To the east, through Pied Piper's Hamelin, the Weser swirls towards Bremen. Between them lies a flat land of dyke and ditch, roads shiny cobbled, timbered farmsteads tall-roofed, tile and thatch. Harlingerland, Ostfriesland, Saterland, Ammerland: some of the richest farming country in Lower Saxony. And an area where, in recent years, one of the most damaging insect pests of Northern Europe —the Beet Fly—has caused heavy losses.

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Editor: Frank Cooke, A.R.C.S., B.SC., A.M.I.CHEM.E., E.D.

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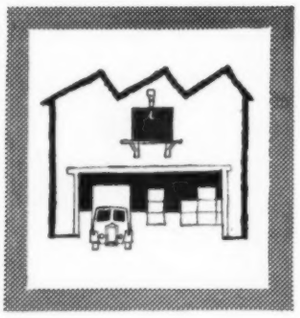

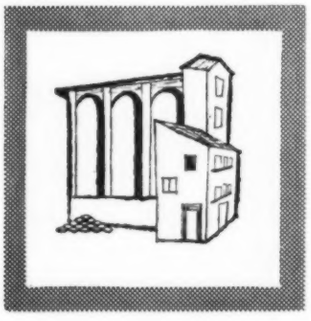

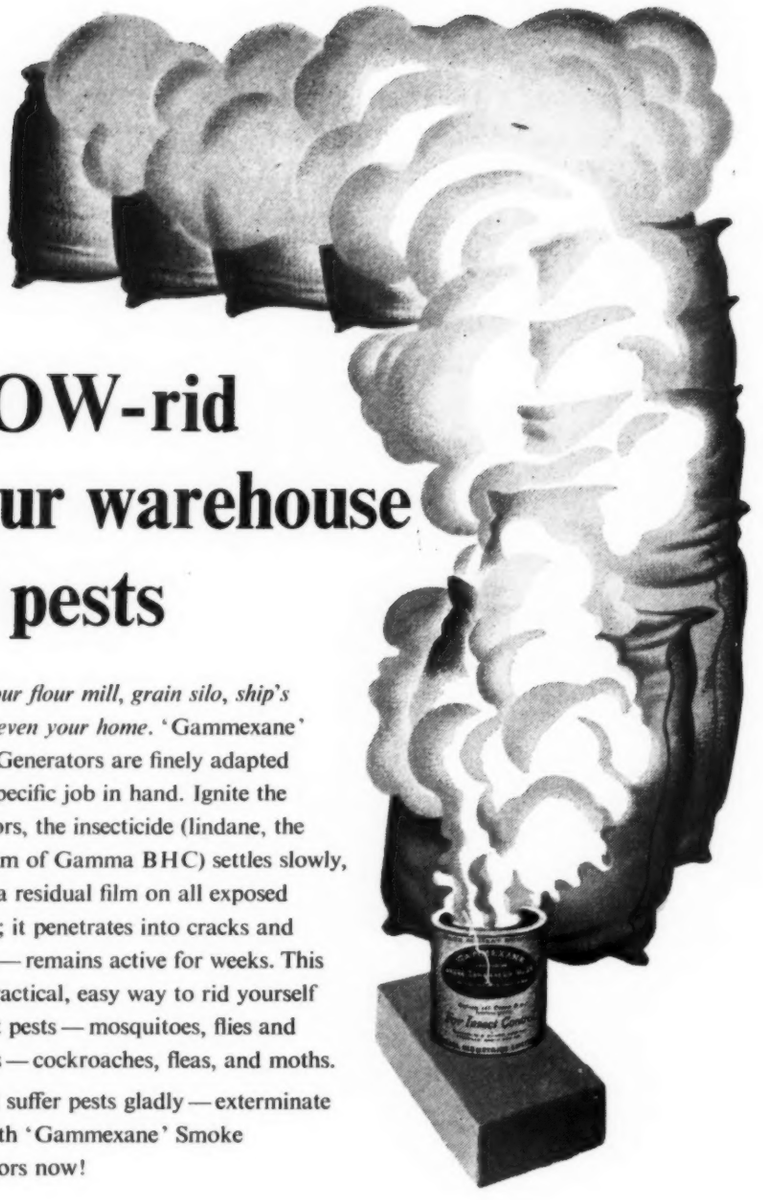

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Editorial Comment

*Untaken harvest**

WE ARE all well aware that pests do serious damage to world crops, both in the field and in storage and shipment, but it is difficult to assess accurately the extent of the damage, which varies from place to place, from season to season, and from crop to crop, quite erratically.

In theory, it should be possible to add to the work of individual horticulturists, market gardeners, farmers, planters and foresters by compelling them to submit annual returns of the estimated untaken harvest of each individual crop caused by specific pests and diseases and by the invasions of specific weeds.

It would also be a comparatively easy matter to put these data through electronic computing machines and so obtain masses of worthless and misleading statistics showing the value of the crop lost in each case and the equivalent agricultural acreage. But these figures would have very little value, except to show which are the most dangerous pests in their economic effects.

One cannot just add up the losses in crop due to different causes, because they are not necessarily additive. Ordish quotes a simple example: ' If, for instance, the sawfly is causing a 20% loss of apples, and apple scab is also causing 20%, it does not mean that the total loss is 40% of the crop. If the sawfly has eaten an apple and caused it to fall, it will not be on the tree for the scab to attack '. The statistical totals could, in fact, add up to some unacceptably astronomical figures, which would defeat their chief object – to make people more conscious of crop losses and more prepared to take necessary action.

Crop losses

WE THUS have to depend on intelligent guesses based on actual surveys, and on this basis it has been estimated that one-third of everything produced from the land, and subsequently shipped and stored, is lost through the depredations of the rival world of animals, insects, bacteria, viruses and competing weeds. Individual crop losses may range from nothing to complete destruction. Thus we may obtain a pure stand of wheat from a resistant strain of treated seed if all weeds, pests and diseases have been kept under rigid control by mechanical and chemical means, or the crop could become a total loss simply through invasion by rabbits.

Similarly, in Hawaii, where in the pineapple fields all the resources of modern agricultural science are used, it is possible to obtain 17,500 pines per acre, or one fruit per plant; yet with two years of neglect the whole crop could be destroyed by the combined action of insect pests, soil viruses and overwhelming weeds.

Thus it may reasonably be concluded that if no counter-measures at all were used quite half of the output of the world's farms would be lost. In the case of the U.S.A., this would be equivalent to $20,000 million worth of food.

On the basis of actual surveys, it has been estimated that in 1950 the U.S.A. lost $4,000 million through pests and $2,000 million through plant diseases; in 1947 the U.K. lost £78 million and Australia £30 million through both pests and diseases. In Holland potato blight control was good and only caused a loss of 2% to 10%, whereas carrot fly destroyed 10% of the crop in 1949.

Cold war in the Pacific

THE PRESENT POSITION with regard to the ravages of the rhinoceros beetle, *Oryctes rhinoceros*, in the Pacific was likened to the ' cold war ', according to Mr. P. D. McDonald, C.M.G., in opening a recent meeting of the Technical Advisory Committee of the South Pacific Commission in Siwa, Fiji. He spoke of the seriousness of the position; the Government of Fiji, in combination with the planters, was waging a control campaign which, he said, was costing £60,000 a year, but they were merely containing the enemy; without further reserves and support it could not be defeated.

The meeting was attended by 11 entomologists from nine Pacific territories, the U.S.A. and New Zealand. After reviewing existing methods of control by field sanitation and quarantine methods and by the use of attractants, Dr. P. Surany presented a review of his pioneer work on beetle diseases which he is carrying out under a Rockefeller Foundation grant. The idea is to control the pest by the spread of a disease which may affect the beetle at some stage in its life cycle.

Control of the beetle by parasites and predators was also discussed and the work done in Madagascar was reviewed. Last year the Commission arranged for collections of parasites and predators to be made in West Africa and in Central and South America.

News from Africa

The Economic Commission for Africa held its inaugural meeting in Addis Ababa over the New Year. It is the latest of the regional commissions set up under the auspices of the U.N. Economic and Social Council, joining those for Europe, Asia and the Far East, and Latin America.

* *Untaken Harvest*. by G. Ordish. Pp. 170. London, Constable & Co. 1952. 15s. Obtainable through Technical Books, 308, Euston Rd., N.W.1

The terms of reference of the Commission are wide, though somewhat vague. They are to initiate and participate in measures for facilitating concerted action for the economic development of Africa . . . with a view to raising the levels of economic activity and of living; . . . to make or sponsor . . . investigations and studies of economic problems and developments within the territories of Africa and disseminate the results; to collect and evaluate appropriate statistics; to perform advisory services to the countries and territories of the region; and to assist in formulating co-ordinated policies among member governments.

There is no specific mention of agriculture, but since most of the economic activities in this vast region are agricultural, it is reasonable to hope for real benefits for African crops. Varying as these do from Tunisian dates to Ghanaian cocoa and Sudanese cotton, they can hardly fail to benefit from the exchange of information on techniques and the practical co-operation that the new Commission will provide.

It seems rather a pity (even if politically inevitable) that full membership should be limited to independent countries in Africa and to metropolitan powers with administrative responsibilities there, with the anomalous result that Nigeria with the largest population of all is for the moment only an associate member (though this did not prevent the Nigerian delegation from playing a prominent and effective part at the inaugural meeting).

It also seems a pity that the Union of South Africa is choosing to take no part in the Commission's work. We can only hope that African crops may yet receive more attention than African political enmities.

Dr. Livingstone, I presume

DR. LIVINGSTONE (1813–73) was a man with a mission, whose motto was: ' Fear God and work hard '. As a missionary and doctor of medicine, he penetrated deep into the heart of unknown Africa and, among other things, discovered the world-famous Victoria Falls of the Zambesi River. But Livingstone was no hurried traveller; he did his journeys leisurely, carefully observing all that was worthy of note with the eye of a trained scientific observer, studying the way of the people, eating their food, living in their huts, and sympathising with their joys and sorrows. It is said that to an exterior, somewhat heavy and uncouth, he united a winning manner and a fund of humour, which enabled him to overcome difficulties and mellow refractory chiefs when all other methods failed.

We were reminded of this in the course of a recent interview with Chief Akin Deko, Minister of Agriculture of the Western Region of Nigeria, who is visiting various countries looking for ' men with a sense of mission '. Nigeria is a country with a rapidly accelerating population, a vast economic potential, and an urgent need for specialists to help in the agricultural development of the country. The period of engagement offered is four years, but with no guarantee of any further employment.

We question the value of short-term assignments, except for the essentially practical purpose of carrying out a simple prescribed technical operation, involving little or no contact with the people of the country, nor necessitating a knowledge of their language, religions, abilities and prejudices. To be successful a ' man with a mission ' must develop a genuine love for, and a complete understanding of, the people amongst whom he must live and work. If he is to obtain their loyal co-operation and affection, they must get to know him personally – he must be tried and tested – *and that takes every bit of four years.* After this it should be possible for him to begin to achieve something.

Livingstone lived and worked for 33 years in 'Darkest Africa '. The direct gains to geography and science are probably not the greatest results of his explorations; his greatest achievement was his contribution to the abolition of the slave trade, against which he had campaigned for years. His revelations raised in Europe so powerful a feeling against this horrible traffic that through him it may be considered as having received its death-knell.

Saving our civilisation

THE ROMAN CIVILISATION made the deserts of North Africa and age-old Egyptian cities are today buried deep in sand. Mesopotamia (Iraq), where arose one of the earliest civilisations, that of Babylon and Nineveh, was once the centre of wheat and barley growing, and where once there was a vast system of irrigated fields, today there is a sea of sand; there is now arid heat where once there was water and vegetation. Great dust storms now blow sometimes for days on end and at other times there are uncontrollable floods.

' The rains have failed ' is a frequent explanation for crop failures, and there is no thought that Man himself can be responsible for a change in climate. It is the vegetation covering the earth that retains the moisture and keeps the air above it cool and damp. When the topsoil is lost, and trees and crops are no more, the climate turns to extremes – great heat and cold – the desiccating climate of the desert; to devastating droughts and destructive floods; without trees and green vegetation to cool the passing clouds and force them to precipitate their moisture, the rains fail and the rivers dry up.

The article in this issue by Gorrie describes the work being done to bring fertile but unproductive soil back into cultivation in both India and Pakistan – literally, the reclamation of land from the desert. He describes the operations of gully-plugging, the construction of dams, bench terraces and contour bunds and the primitive methods still employed. He finally emphasises the need for modern earth-moving machinery to speed

up these operations and ensure their successful completion.

The article by Behr and Thomas shows that contour bunds can be made more cheaply, more quickly and more satisfactorily by using a tractor than by man and donkey power. Perhaps the most important deduction is that a man using a tractor can work 250 times as fast as a man with only a hoe, or *mamoti*. This is a matter of fundamental importance to the future of our civilisation, because one of the danger spots is India, with its population of 450 million people, for whom food is the first essential.

The short-sighted will object that the machine will create unemployment, or, alternatively, it will not create employment, but it is obvious that *without the machine the work can never be completed.* It is essential to put first things first. The most important thing is not the maintenance in full employment of an army of manual workers under conditions of increasing semi-starvation; the first essential is to reclaim as many acres as possible, as quickly as possible.

With more land made available for cultivation and a higher level of productivity there will be more work and more food and the resulting higher level of nutrition will then make it possible to establish manufacturing industries on a sound foundation. Never before in history has it been possible to reclaim land from the desert on such a vast scale so quickly and easily.

The small man

THE essential needs of Man are air, water, food, shelter and the sun as a source of light and energy. We have gone beyond these simple needs and today a host of luxuries have become essentials. We must move faster and faster – the steamer, the locomotive, the motor car, the aeroplane and now the space rocket – and we are not a bit the happier. Somehow we are trying to escape from the problems of this world; to write off the world as a bad job and look for new worlds to conquer, when our major problem still remains the ever-increasing production of food. It is a problem which we are inclined to leave to others or to obscure with political issues.

One of the greatest threats lies in the changing systems of land tenure. The collective farm system has failed because of the over-controlling paper bureaucracy – see WORLD CROPS, 1957, **9**, 497, and the system of land settlement in some newly self-governing countries, whereby one blooming man gets one blooming acre and gives one blooming vote to the political party which gave him something for nothing, also is a failure, because the 'little man' engages in little more than subsistence agriculture and is generally indifferent to the needs of others, so long as his own simple needs are met.

The ownership of land carries with it a responsibility. Under a sound agricultural economy, one man is able to produce food or raw materials to meet the needs of 20 others, and that is why over-crowded countries such as Britain are able to carry on. Men farm the land because they love the life and in spite of the heavy pressure of population there is little fragmentation of farms, because it is recognised that small farming simply does not pay.

The fiftieth state

THE GRANTING of statehood to Hawaii and its complete integration into the United States of America is a significant and long overdue development. The *Daily Telegraph*, in reporting this event, commented that this illustrates the difference between British and American colonial policies in that American dependencies are not granted their independence, but are included as part of a federal union. This is not strictly correct, for in 1934 the territory of the Philippines was not received into the Union, but became a republic in its own right.

The fundamental difference between the State of Hawaii and the Republic of the Philippines is economic and demographic in that the principal industries of the former are the production of canned pineapple and refined sugar, both highly organised factory industries, whereas in the Philippines the two leading industries are coconuts and rice, both essentially rural industries. As regards populations, whereas in the new State the indigenous Hawaiian forms a small minority, in the Republic the overwhelming majority of the population are Philippinos. The nearest parallel in the Commonwealth would be Australia and Ceylon.

Hawaii's economy is self-supporting. More than a million tons of sugar, worth nearly $150 million, are produced annually from over 200,000 acres of cane, and she produces 65% of the total world production of canned pineapple, worth about $115 million, from about 75,000 acres under this crop.

Winning of statehood means a well-deserved victory in a long fight which Hawaii has waged since 1903, when it made its first petition to Washington.

Floreat Kew!

THE BEAUTY of the Royal Botanical Gardens attracts more than a million visitors a year from all parts of the world, but scientific research is the main function of these gardens. Much of the work at Kew consists of the accurate identification of plants and the despatch of botanical information, seeds, cuttings and planting material to agricultural stations and botanic gardens throughout the world.

Rubber, pineapple, cocoa, coffee, quinine, nutmeg, cloves and bread fruit are some of the many plants of economic value which have been introduced by Kew to countries overseas. The Library, Herbarium, Economic Museums and the Jodrell Laboratory

together house a vast collection of reference books and preserved specimens and in the extensive gardens and vast plant houses there are some 45,000 species and varieties of ornamental plants, shrubs and trees. Australia House, specially constructed in aluminium and glass, is a recent donation, in which are housed plants from the arid areas of Australia.

One by one the former colonies and dependencies are becoming self-governing and a new relationship with the Mother Country is emerging, in which the Royal Botanic Gardens is likely to play an increasingly important part because the scientific staff is in a unique position to provide a staging post for the exchange of plants and planting material, and as a clearing house for plants requiring inspection and fumigation before being transferred from one country to another.

The Gardens were established in 1759 and they are thus 200 years old. To mark its bicentenary it has been decided to increase its usefulness to world agriculture by building a new Economic House to display plants and trees of economic importance and to produce plants for distribution among research establishments in Commonwealth and overseas countries.

It has been estimated that a plant house fitted with all modern devices will cost about £40,000, and this sum is now being raised by voluntary contributions as a mark of appreciation by the Friends of the Gardens. We feel sure that among our readers there are many who are aware of the enormous debt which the vast rubber industry alone owes to Kew and who would like to associate themselves, their business associations or their countries with this worth-while cause. The Editor will be pleased to forward any cheques received, which should be made payable to the Kew Bicentenary Fund, and they will be acknowledged in these columns.

Overseas visitors will be interested to learn that the bicentenary will be celebrated on 2 June by a garden party in Kew Gardens, which is to be attended by H.M. the Queen and Prince Philip.

'. . . and here we have Dr. Jawant Singh from India, who is engaged on a study of the effect of plant tranquillisers'
(see WORLD CROPS, 1959, **11**, 119)

Hybrid cotton

THE SUPERIOR VIGOUR sometimes shown by hybrid progeny is now widely appreciated. The outstanding example of success in the use of this characteristic is maize. This plant is normally cross-pollinated and when inbreeding is forced on it considerably reduced vigour results; when such inbred plants are crossed a vigorous progeny results, giving higher yields and showing greater uniformity than the open-pollinated maize from which the inbred strain was originally derived.

Application of this principle of inbreeding to other crops is engaging attention and promising results have been obtained with a number of crops, including sorghum, onions, sugar-beet and tomatoes. Dr. Frank M. Eaton, plant physiologist of the U.S. Department of Agriculture, is primarily responsible for the initiation of studies on the use of selective gametocides to prevent pollen from developing in certain strains of cotton, thereby making it easier to obtain hybrid cotton.

Under natural conditions, cotton is insect-pollinated. This has limited hybrid production to hand pollination, a laborious process because hybrid vigour reaches its maximum only in first-generation crosses, and the cross must therefore be repeated for each new seed supply. The cross is therefore obtained by effecting male sterilisation in a field of one variety of cotton, the pollen for its fertilization being obtained by natural agencies from a second strain of cotton grown nearby. Varieties of cotton differ in their response to gametocide treatment; therefore, by spraying gametocide on a field planted with two cotton varieties, one of which is susceptible and the other non-susceptible to the chemical, the former becomes male sterile and thus serves as the female parent, while the latter variety supplies pollen for its fertilization, thus producing seed of hybrid cotton.

By the use of these new chemicals it is hoped to devise means for large-scale production of high-yielding hybrid cotton, while it is possible also to produce hybrid cotton with greater disease resistance and superior fibre qualities. Future developments of this investigation will, therefore, be followed with great interest.

Land Reclamation in the Old and New Punjabs

R. MACLAGAN GORRIE, D.SC.
(*formerly Conservator of Forests in the Punjab*)

Earnest efforts are being made by both India and Pakistan to deal with soil erosion. This is an up-to-date report on what is now being done on both sides of the Indo-Pakistan boundary in terms of land reclamation and soil and water conservation.

The Badlands between Chakwal and Nila in the Jhelum Salt Range

IN the undivided Punjab under the British regime the phrase 'land reclamation' was appropriated by the Irrigation Branch and applied in a somewhat restricted sense to efforts to reclaim irrigable land which had gone out of cultivation owing to water-logging and the accompanying concentration of saltpetre at or near the soil surface. This is an immensely serious problem, for the amount of land going out of cultivation is reported to be in the neighbourhood of 30,000 to 40,000 acres a year.

The recommended cure of sinking innumerable tube-wells and then pumping to lower the water-table has not progressed very far. The alternative – the provision of a waterproof double lining for the main channels throughout their length to stop the worst seepage – has made good progress on some of the new canals, such as those of the Jinnah Barrage at Daud Khel, a few miles below Attock on the Indus, and also on some new systems in Lower Sind, where the Ghulam Mahamad Barrage was opened at Kotri in 1954. Little progress has, however, been made by either country with the lining of the older canals.

Un-irrigated land reclamation

Let us now turn to the wider implications of 'land reclamation' as applied to the much larger areas of un-irrigated land, which are the subject of this report. The old Punjab owed its strong position as a wheat exporter to the yield in years of good rainfall from the *barani*[1] lands in the rolling country of the Jhelum Salt Range and the Rawalpindi plateau. Year by year a solid minimum of irrigated wheat supplied the local markets, but it was in the years of good rain, when the *barani* lands produced a bumper crop, that a notable contribution could be made to world supplies. The same still holds good, and as the larger *barani* tracts lie west of the new border India has less of a surplus from her Punjab sources than has Pakistan in a good season.

Extent of problem

To obtain an idea of the size of the problems in the unirrigated land we have to consider (1) the actual arable acreage, much of which needs better soil conservation practices; (2) the extent of ravined and gullied land which is reclaimable; and (3) the desert fringe which is apt to blow away.

On the Indian side, the districts of Hoshiarpur, Ambala, Kangra and Gurdaspur have about 700,000 acres of arable which are definitely in need of contour - terracing, and there are 400,000 acres of badly ravined ground in and around the Siwalik Range, which runs parallel to and below the Himalayas. On the Jammu border (adjoining Sialkot and Gujrat), which is now part of Indian Kashmir, there are at least another 150,000 acres of possibly the most fantastically ravined 'badlands' anywhere in the world. The desert fringe in Hissar, Rohtak, Gurgaon, Karnal and Ferozepore lies south of, and intermixed with, the irrigated tracts and amounts to roughly

Gully-plugging in the Jhelum Salt Range, showing refinements in check dam construction

three million out of the total of ten million acres of these five districts.

On the Pakistan side there are in West Punjab 40 million acres (as compared with Scotland's 20 and England and Wales's 37). Out of these 40 million acres of West Punjab, 14 million are irrigated, including Bahawalpur and the Mianwali Thal. The unirrigated cultivation is about 8½ million, and out of this 2½ million is badly in need of terracing. Then, apart from the existing cultivation, there are two million acres of ravined land, much of which could be turned into a real national asset if it were broken down into terraces.

Apart from West Punjab, there is the rest of West Pakistan with another 160 million acres, but out of this one can only make a guess that there are at least four million acres of ravined land; much of this could be reclaimed by terracing it into benches, but a great deal is sub-marginal for rain-fed cropping, unless water trapping could be done by making, say, 20 acres of catchment for each acre of ponded field. Even in the most arid tract immediately north of Karachi in the Kohistan Mahal *ilaqa*[2] of Dadu with 3 in. rainfall, or less, this type of ponding could be made very effective by improving and enlarging the ancestral water diversion devices.

Erosion and reclamation

Land reclamation in this wider sense of the term was in the old Punjab largely a matter of stopping the ravages of erosion in the uplands. The Siwaliks of Hoshiarpur and Ambala had been disforested a century ago, partly through increased pressure of population, partly through specific demands for wood fuel to burn bricks for the Sirhind and other early canal building, and partly to the administration's disregard of what are now known to be the ecological consequences of handing out forested hill country for the villagers to destroy in their own time.

The Siwaliks geologically are about the most easily eroded strata anywhere in the world, because they are the up-ended dip of thousands of feet of unconsolidated sand-rock and soft shales. The Salt Range and the Potwar plateau of Rawalpindi further west and further out from the main Himalayas are almost as bad; they contain some outcrops of gypsum as well as shales, but the sandstone and limestone are somewhat more resistant than the Siwalik sand beds. Infrequent but extremely heavy rainstorms bring down every torrent in a spate of mud and grit which chews up every erodable hump in its path and is later spewed out over the flooded plain to smother any existing fields.

Torrent reclamation in all these uplands consists of (1) re-establishing forest cover on the upper parts of each catchment; (2) protecting the fields along the confined stretches of the valley; and (3) canalising the torrent after it emerges on to the sandy plain below. If moisture is properly conserved in every field by contour-terracing, the deep sandy loam yields excellent crops of wheat, but the torrents must be confined and canalised by means of tree and grass shelter-belts along each bank.

Co-operative effort

This has been proved by the Forest Department in a number of places. The best progress was made in those districts where some spirit of co-operation amongst the peasant farmers made it possible to get concerted action on control of grazing above to allow afforestation, and in the valley below to establish and maintain these stream-side shelter-belts. The Hindu *Jats*[3] in Hoshiarpur were undoubtedly best in this respect, and by 1939 there were some 400 co-operative societies for torrent reclamation and forest control in Hoshiarpur; out of these, about 150 were doing some really effective work along their torrent beds and making a good income from the forest products from well-managed village forests.

A demonstration was established in the Maili-Bachoi catchment, where a 10-mile perimeter of eroding Siwalik ridges was taken up in 1938-39 for intensive afforestation and 'gully-plugging', benching-off the torrent channel itself from the top downwards with frequent rubble check-dams to reduce scouring and help vegetation to establish itself in the arrested mud. The results have been spectacular: erosion has been reduced and the stream-flow is becoming appreciably nearer to perennial.

In Hoshiarpur and Ambala districts today land reclamation is being taken up under the Community Development Organisation as a branch of civil administration. Garshankar *tahsil*[4] has been taken up for intensive working as a 'national block' and some of the village groups are attempting torrent reclamation under the guidance of the forest staff. The chief difficulty is that so far very few of the village level workers, who are the rank and file of the Community Development staff, have had any special training in any sort of soil conservation, and even fewer in the special types of work needed locally, so they have to depend on the few specialists who can be spared from regular forest work.

Primitive methods

In terms of straightforward contour-terracing, which goes by the Punjabi name of *watt-bandi*, using a pair of bullocks drawing a light wooden scoop, this has for generations past been accepted as the essential basis for raising rain-fed crops. The rainfall diminishes from 35 in. to 45 in. in the east of the old province to 8 in. to 10 in. in the west, and the interesting thing is to see how careful the farmer becomes over his *watts*[5] as the rainfall decreases to the westward.

In the eastern districts they only want to catch enough water to secure a crop and the excess is allowed to rush off into the nearest torrent bed. In the west they know pretty well that unless they catch the whole of the monsoon rain and the winter rain their wheat crop in the spring will be a failure. Conversely, the grazing grounds in the west are in a much worse condition on the whole than in the east, where a more consistent monsoon keeps them in better ecological condition than in the more extreme climate of what is now Pakistan.

West of the Jhelum Salt Range one finds a special type of soil-saving dam built actually in stream beds to trap and spread the load of silt which is washed off the grazing grounds. Many of these built by local land-owning families over several generations are ambitious and well-planned projects with three basic essentials: an earth dam to block the torrent bed completely; an ample spill-way to make sure a super-flood can spill away through, preferably well away from the made-earth of the bund; and a deep-set sluice, by which the water in the trapped mud can be drained away before ploughing and sowing.

Modern methods

The earth-work for these dams has in the past been mostly done by donkey pannier, a slow and laborious business, so the land-owners were more than delighted when the Forest Department demonstrated the use of bulldozers and other mechanical equipment. Owing to the difficulty in getting equipment, however, the slow work with the donkeys still continues today. Earth-moving machines were first used for soil conservation work in Hoshiarpur and Ambala in 1938 to supplement the bullock-drawn *karah*[6], and it was soon proved that it was commercially feasible to employ bull-dozers on reclamation, particularly where ravines and gullies had cut too deep for the *karah* to be effective and where the inroads of new gullies were getting beyond the capacity of the individual peasant cultivator to defend his own fields.

Up to the date of Independence in August 1947 there was little of this mechanised approach in what is now Pakistan, except to get the army to use the Pabbi Hills of Gujrat as a training ground for their bulldozer operators. But the experience so gained showed very clearly that this was the answer for the reclamation of some of these millions of acres of badlands.

Subsequent to Independence, several secondhand machines were secured by the Pakistan Forest Department and worked on a subsidised basis with the farmer paying a share of the cost based on his land revenue assessment – wealthy men paying three-quarters, the ordinary *khudkhasht*[7] farmer one-half, and poorer men one-quarter of the working cost. These machines, when received, were nearly worn out and spares were hard to get. Plans for the purchase of a fleet of new machines for land reclamation were, unfortunately, upset by the unexpected death of the Inspector-General of Forests for Pakistan in 1948.

Bulldozing the Badlands with an Army D8 in 1945

The present position

A recent visit to Pakistan, however, revealed that the Forest Department

A soil-catching dam blocking a torrent bed. This was built by donkey panniers

is still continuing with the work of ravine reclamation with a few machines – mostly D4s and D6s – in the immediate neighbourhood of Rawalpindi. Wheeled tractors are also being used by American ' Point Four ' workers in several demonstrations of continuous contour terraces realigned across the old pattern of small rectangular fields. This work is of obvious value on the gentler slopes of up to 1 in 50, but can only be fully demonstrated if the consolidation of holdings is agreed upon and carried out as a part of the operation, so that each cultivator now gets a strip within one of the new obstructions.

On the Indian side, the value of the Hoshiarpur gully-plugging work was lost sight of after August 1947, but has since become more fully appreciated by the down-stream communities, some of which have suffered much from flood damage, and noticeably more along the untreated than the treated torrents. The latter show a clear tendency to establish a perennial flow.

A good field of wheat established in a reclaimed torrent bed behind a soil-catching dam

[1] *barani:* rain-watered.
[2] *ilaqa:* district.
[3] *Jat:* agriculturist caste.
[4] *tahsil:* sub-district.
[5] *watt:* ridge or bund.
[6] *karah:* scoop.
[7] *khudkhasht:* owner-cultivator.

Reclaiming Land in Holland

Most Dutchmen have grown accustomed to the idea that the agricultural production per area unit in their country is the highest in the world. They think it normal that the ground water in their country is everywhere under perfect control and that every farm is well connected with the road system.

The great agricultural depression which afflicted their country some 70 years ago and threatened to ruin the farm population is forgotten. Large tracts of the now fertile and prosperous agricultural areas were then inaccessible swamps and barren moorlands. The depression was a challenge to the people and was duly met. Plans were made for rural development. Large stretches of moorland were transferred to private companies to make these soils productive.

In 1888 a society for purposes of general utility was established under the name of the ' Netherlands Land Development and Reclamation Society '. This society is a private enterprise. Its task is to assist and advise its members in the reclamation of moorland, swamps and fens and, in general, to improve the productivity, in its widest sense, of land and water.

It is hardly possible to give a summary here of the thousands of acres of waste land that have been reclaimed, the arable and grasslands that have been improved and the forests that have been planted. The drainage ditches that have been dug, and the brooks that have been improved, have a total length of more than twice the circumference of the earth.

Putting the finishing touches to a mechanically dug drainage channel in Holland

The most modern equipment is used in the execution of the projects destined to increase not only the productivity of the farmlands and afforestations, but also to the building of recreational objects, so very important in a densely populated country like Holland.

Technical News

Articles in the May issue of some of the other journals of the Leonard Hill Technical Group include the following:

Corrosion Technology. – ' Review of the Corrosion Exhibition '; ' Sewage Treatment Plant in Australia ' by J. Grindrod, B.A.(COM.); ' Laying Plastic Water Mains '.

Dairy Engineering. – ' Recent Dairy Engineering Developments in Eastern Europe ' by F. Lang.

Paint Manufacture. – ' Silicone Resins in Surface Coatings ' by Dr. D. R. Goddard and E. A. Mason.

Specimen copies of the above journals are available on application to Leonard Hill House, Eden Street, London, N.W.1.

Contour Bunding

A. B. P. G. BEHR, B.SC.(AGRIC.), A.M.I.B.A.E., AND M. THOMAS, B.SC.(AGRIC.)

FOR generations Indian farmers have been cultivating their lands with little understanding or regard for the need to conserve the topsoil and their unconscious neglect has resulted in hundreds of millions of acres of once rich and fertile land becoming increasingly unproductive and barren. The Government of India, realising the seriousness of the problem, has launched a soil conservation campaign on a nation-wide basis and is subsidising a 30-year scheme for the construction of contour bunds on all lands with slopes of between 2% and 12%; for slopes above 12%, bench terracing is recommended.

In few countries in the world are indications of soil erosion so widespread as in India, since out of the 450 million acres of potentially productive land about 150 million acres are ravaged and eroded. Following extensive trials carried out near Coimbatore in Madras State, a technique has been evolved for the rapid construction of bunds by mechanical means.

Man-made bunds

The work is, however, progressing very slowly and is also extremely expensive. On average one man can construct not more than 10 lin. ft. of earthwork a day and, depending on the soil conditions, the cost is from Rs. 10.00 to Rs. 13.50 per 1,000 cu. ft. (or 200 lin. ft. of bund only 15 in. high).

Considerable additional expense is incurred with these man-made bunds for their maintenance, as they are not properly compacted and can easily be breached if heavy rain falls in the weeks immediately following their construction. This is because they are made merely by heaping loose soil on unprepared land; they have no foundation or 'keel' to hold them, to increase resistance to percolation and to prevent breaching.

Time is also an essential factor in all these operations, for the land is available for the construction of earthworks for only relatively short periods between cropping seasons. In Madras State alone the annual target is the construction of bunds on 20,000 acres at a cost of well over 6 lakhs of rupees and this is hardly an economical proposition.

Machine-made bunds

Extensive investigations into the possibilities of constructing bench terraces on steep slopes with tractor-powered implements had been carried out with great success at Ootacamund in 1958. It was, therefore, decided to test the effectiveness of the same equipment for the construction of contour bunds on more moderate slopes. Vada Chittoor village in Pollachi Taluq, 17 miles from Coimbatore in Madras State, was the centre selected for these trials, which were carried out in co-operation with Mr. Sharma, Deputy Director of Agriculture, Coimbatore, and Mr. Nainar, Assistant Agricultural Engineer (Soil Conservation), Coimbatore.

The land was a red loam, somewhat stony in nature, with a rocky subsoil at a depth varying from 9 in. to 14 in.; the average slope was 4%, but there had been no effort by the villagers to arrest soil erosion, with the result that much of the topsoil had already been lost. The crops generally grown are *cholam* (jowar) and groundnuts, neither of which bind the soil.

Cheaper, quicker, better

It soon became apparent that contour bunds could be built more cheaply, more quickly and more satisfactorily by mechanical means than by manual labour. Exact costs, including depreciation and interest on capital, were kept and these show that machines can be used to construct contour bunds at less than one-tenth the cost of manual construction and that further savings are possible, since less maintenance is necessary, because the machine-made bund is more compact and is keyed into the ground.

A comparative study of the time and labour involved with manual labour and in mechanical construction shows that on average 30 men will be required to make bunds for one acre in a day at a cost of from Rs. 30.00 to Rs. 40.00. Against this the tractor can make bunds for the same area in one hour at a cost of from Rs. 3.84 to Rs. 4.62.

Equipment

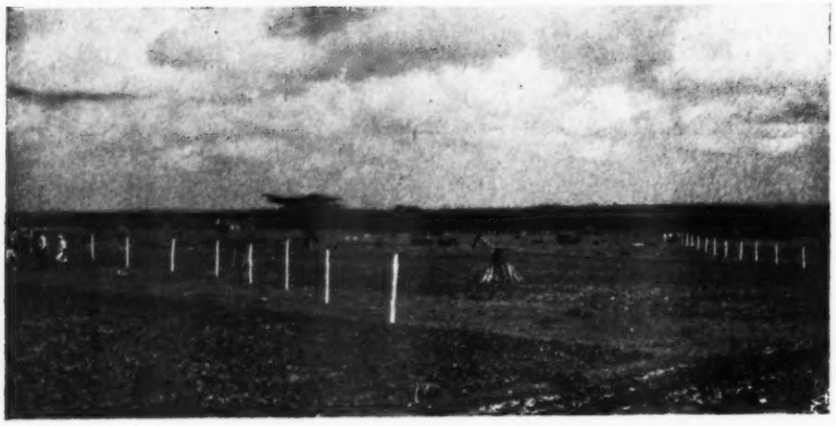
Preliminary tests and calculations have shown the anticipated rate of construction of contour bunds with the minimum amount of Massey-Ferguson equipment. This production, in round figures, indicates that one tractor with a plough and a multi-purpose blade terracer, supported where necessary with a subsoiler, is capable of constructing earth-works at approximately three units (3,000 cu. ft.) in one hour. This is the average volume of earth-work required for bunding one acre of land.

The rate of construction can be considerably increased and the cost reduced by adopting a Work Unit of equipment consisting of three tractors, a reversible plough and two multi-purpose blade terracers. Such a team could be expected to turn out completed structures at the rate of 9–12 units an hour, depending on conditions. This is equivalent to providing soil and water conservation protection for erosion-prone slopes at the rate of 3–4 acres per hour.

Operational technique

The work takes place in three stages. First of all the land needs to be accurately pegged out along contours with a vertical interval of 4 ft. or horizontal intervals of 250 ft., whichever is less. This naturally depends on the slope, which may vary from 2% to 12%. Then the ground is subsoiled and ploughed on both sides of the contour. A 15-in. bund is then built and consolidated, after which, if necessary, the bund is raised and broadened to give an 18-in. bund.

The operating details are as follows:



← Contouring

The first operation is the accurate staking of the contours. The vertical intervals, the horizontal intervals and the bund specification must depend, of course, on the slope of the land, the average rainfall and the incidence of the rainfall. In Madras, with a 4% slope, the normal practice is to site the bunds at a V.I. of 4 ft, or a H.I. of 250 ft., whichever gives the smaller horizontal interval.

Subsoiling →

With heavy, stony or rocky subsoil conditions it is sometimes necessary to use the subsoiler at close intervals and at maximum depth – 16 in. to 18 in. – to loosen rocks and boulders before ploughing.

← Ploughing

Under normal conditions bund construction is started by throwing two deep furrows, one on each side of the contour line, with a reversible plough, leaving an unploughed centre strip, 32 in. to 34 in. wide, which 'keys' the bund to the ground.

A total of three rounds of ploughing is carried out to provide loose soil for forming the bund.

Bund formation →

The blade terracer, with its blade angled at 40°, is then used to throw the soil to the centre of the bund and on the second run the bund begins to take shape.

← Bund consolidation

More soil is collected during the next six runs; the height of the bund is increased and it is consolidated, but it will be noted that these operations leave deep channels at the foot of the bund, which need to be filled in.

Smoothing and filling →

Soil needs to be gathered from the adjacent land and two quick runs, one on either side, are normally sufficient to complete this operation and give a satisfactory finish. At this stage the dimensions of the bund will be: height, 15 in.; width at base, 8 ft.; volume of earthwork per 330 ft., 1,650 cu. ft. When the slope is mild this will be sufficient. Total time, 42 min.

← Bund raising

On more severe slopes, or in places subject to severe storms, it will be necessary to increase the height. The blade terracer is again employed with the pitch of the blade increased to gather additional spoil, to increase the slope and to produce a flat-topped bund. In all, four more runs are made.

Final grading →

The final two runs are to fill up the channels at the foot of the bund and smooth the land into the base and fill up the channels with additional spoil as before. The completed bund has the following dimensions: height, 19 in.; width at base, 9 ft.; width at top, 1½ ft.; volume of earthwork per 330 lin. ft., 2,743 cu. ft. Total time, 55 min.

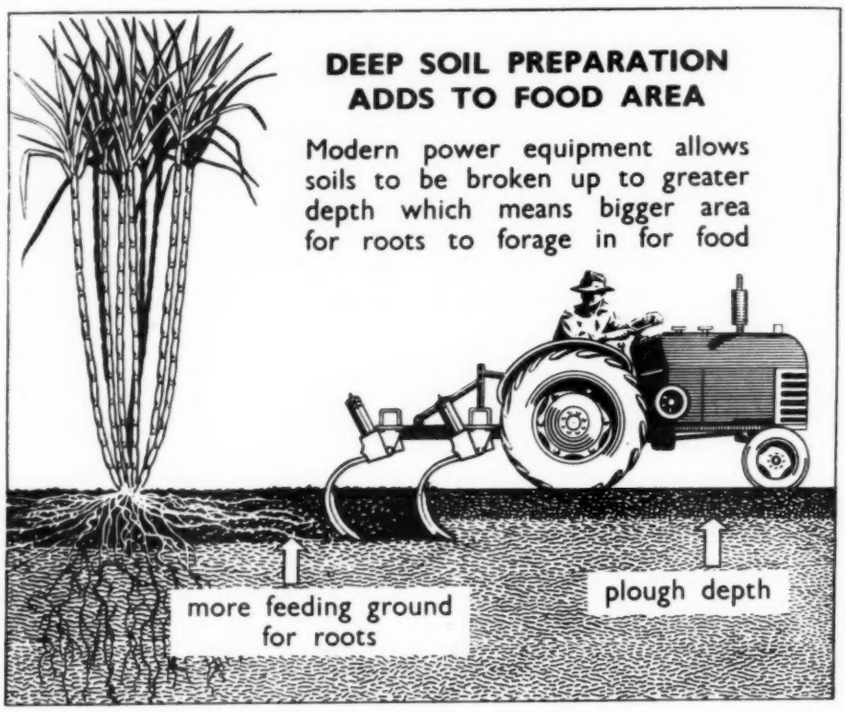
Photos: Massey-Ferguson (India) Ltd.

Sugar Cane in New South Wales

1—Preparation of Land

W. G. LOWNDES, M.SC.
(and Officers of the Colonial Sugar Refinery Co. Ltd.)

Maximum intake of plant food depends on the abundance of available plant food and water in the soil, an extensive root system to collect the plant food and the absence of other plants (weeds) which compete for available plant food.


DEEP SOIL PREPARATION ADDS TO FOOD AREA
Modern power equipment allows soils to be broken up to greater depth which means bigger area for roots to forage in for food
more feeding ground for roots
plough depth

BEFORE replanting sugar-cane the farmer must first destroy the stubble of the previous crop and when ploughing it out he will have four objectives: (1) to kill the old cane stools so that there is no regrowth; (2) to break up the soil as deeply as possible; (3) to mix the old cane roots and trash through the soil; and (4) to prepare a seedbed for the planting of the legume crop.

The reason for the first objective, the killing of the old cane stools, is obvious, because the old plants must not be allowed to grow again and interfere with subsequent work.

Deep working

The second objective is to break up the soil as deeply as possible. One important reason for doing it at this stage is to break up and loosen the soil which has been compacted by tractor tyres. Damage to soil structure has increased greatly with the mechanical loading of cane and the use of tractors for hauling. Harvesting has often to proceed while the ground is wet, and this leads to still more serious damage to soil structure.

Compaction of the soil by tractor tyres goes deeper than is generally realised. Some effect has been measured to depths greater than 4 ft. Really serious compaction occurs at least to 12 in., damaging soil structure in the most important part of the soil.

Importance of soil structure

The small particles of sand, silt and clay which make up a good soil should be grouped into fairly stable crumbs or granules. Their size and the strength of the bonds which hold them together vary considerably. A feature of a soil with a good structure is that the crumbs remain stable even when wet. In other words, they do not turn into mud, blocking up the spaces between other crumbs so that the soil packs hard as it dries out.

The spaces between the soil crumbs form continuous channels from the surface down to below the level of root growth. These allow the downward movement of excess water through the soil, a form of drainage just as important as surface drainage.

These channels assist in the movement of gases through the soil, particularly the escape of carbon dioxide released by plant roots and soil organisms, and the replacement of this carbon dioxide by the entry of air. They assist in holding moisture in the soil on the surface of the soil crumbs, where it is readily available to the roots of the plants. They give the best conditions for the vigorous growth of roots which push readily along between the soil crumbs.

Restoring soil nitrogen

The third objective in ploughing out is to incorporate the old cane roots, stubble and trash into the soil. This assists their decomposition and, if the soil is well and deeply worked, both drainage and aeration are improved and decomposition is more rapid.

The roots, stubble and trash left behind from a cane crop may amount to as much as $4\frac{1}{2}$ tons of dry matter per acre. These residues are important for several reasons:

Their decomposition in due course provides nitrogen to replace some of the nitrogen which has been taken from the soil through previous harvests. However, for some time immediately after the cane residues are ploughed in, the amount of soil nitrogen is actually lowered.

This is because the soil micro-organisms increase very rapidly and in feeding upon the organic matter

The trash from the previous crop – tops and roots – amount to about 4½ tons per acre. Here a single-furrow plough has been used

they use up the nitrogen already available in the soil. The amount of nitrogen available in the soil for plants therefore remains low until the decomposition of the organic matter is complete, then the soil micro-organisms die and their nitrogen becomes available in the soil.

This is one of the main reasons for resting land during the fallow period, for while this decomposition is going on the soil nitrogen is so low that another cane crop cannot be established without very heavy applications of nitrogen fertiliser.

Another contribution of the ploughed-in cane residues is in building up humus. This is of great importance in many ways, including the fact that humus improves soil structure by holding the soil crumbs together. The lignins and resins from cane residues decompose slowly and have special value in improving the supply of humus in the soil.

The seedbed for legume crops

The fourth objective of ploughing-out is to prepare a seedbed for the sowing of a legume crop. This will do best on soil which has been well broken down in depth, so that there are good conditions for its roots to develop and good drainage conditions in the soil for excess water to drain downwards.

Ploughing-out

The most popular implement on the Northern Rivers for ploughing-out cane is the *rotary hoe*. With this implement the old cane roots and trash are chopped up and turned in to the soil. Sometimes, especially on big stools, or if the rows have been hilled up, a tandem disk harrow is used ahead of the rotary hoe to level off the surface.

The use of the rotary hoe does not, however, achieve the important objective of breaking up the soil deeply. There is also the risk that on some soils, and especially if used when the ground is wet, a 'hard pan' may be produced. This is bad both for drainage of water through the soil and for root development of the legume and of the cane later on.

If the rotary hoe is used for ploughing-out, it should always be followed by deeper working with a plough, grubber, chisel plough or the deep-working tine implements which are fitted to toolbars.

Cane ploughed-out by means of a rotary hoe is broken up into small pieces and usually there is very little regrowth. When a *plough* is used, either disk or mould-board, the cane is cut into larger pieces, many of which grow again. It is therefore usual to follow a ploughing with a disk harrowing.

For satisfactory work a mouldboard plough should have a sharp disk coulter and a properly pointed share. The disk of the dish plough should be sharp and particular attention should be shown to the setting of the plough.

Many farmers working on shallow soils underlain by stiff clay aim to bring up a little of the subsoil clay at each ploughing. There seems to be little ill effect from this, provided that it is done in very gradual stages.

Surface drainage

Whatever method is used in ploughing-out cane and preparing the ground for the legume crop, it is essential that good surface drainage be established before sowing the legume, otherwise there is a risk of disease and failure of the crop, which is growing during the wettest period of the year.

Good drainage is essential for the healthy, vigorous growth of the legume.

The tandem disk harrow which is used to level off the ground and smash up the residues

After the tandem disk harrow the rotary cultivator is used to plough in the crop residues

It is also necessary for satisfactory decomposition of the old cane residues, because the micro-organisms which decompose them require good soil aeration and drainage. The soil must be kept 'sweet' at every stage and must never be allowed to become waterlogged and sour.

Therefore, before sowing the legume crop, surface field drains should be made with the mouldboard plough or a drain plough. Cross-drains should also be made where necessary.

(*To be continued*)

The second part of this article on Sugar Cane in New South Wales deals with the Use of Legumes and will appear in the June issue.

Coconut – Tree of Plenty

The second session of the FAO Group on Coconut and Coconut Products was held in Manila in October 1958. Nineteen governments* were represented at the session and representatives of the South Pacific Commission and the International Association of Seed Crushers (I.A.S.C.) attended as observers.

The main subjects on the agenda for this session were economic and statistical matters, questions of copra quality and technical factors affecting supply.

It was noted with satisfaction that a regional coconut statistical expert would be appointed by FAO in mid-1959 to conduct pilot surveys in order to evolve methods for estimating coconut production and other basic information on national coconut populations.

The Group studied and approved the report of its expert sub-committee on copra quality and standards. The report dealt with two major aspects of the subject: (i) processing improvement; and (ii) commercial grading standards in international trade. The findings stress that proper drying is the crucial factor in producing good-quality copra, and urged member governments to make a request for expert assistance on the techniques and economics of copra drying.

It was recommended that FAO provide an expert to make a detailed study of the best methods of drying, constructing and operating driers, particularly those made of locally available material; and to assess the capital and other costs involved in relation to the likely increase in return. It was proposed that the results of this work should be disseminated through a three months' training programme for trainees from copra-producing countries, who would be engaged in extension work. It was suggested that the research and training programme should be conducted in the Philippines, where facilities would be offered.

With an active programme on drying methods, internal marketing improvements and the establishment of principles for setting standards agreed to by both consumers and producers, the sub-committee would later proceed to an examination of means of establishing grades and specifications, and the necessary marketing measures and inspection services. It was proposed that the next session of the sub-committee should be held in Ceylon in August 1959, when there would be opportunity for practical study of the marketing organisation and operation of co-operatives in that country.

An *ad hoc* sub-committee discussed crop production problems (1) improvement of yields through better management, including fertiliser use (2) improvement through selection and breeding of high-yielding palms (3) prevention of losses from major pests and diseases (4) processing and utilisation research and (5) the future pattern and organisation of research. The sub-committee commended action taken to appoint an FAO expert in 1959 to study the status of research and exchange of results, and the proposal to establish an international coconut bureau for this purpose. In view of the extensive economic losses caused by the spread of diseases of unknown origin, the Group also suggested that FAO convene a working party of experts on plant pathology and virology.

It is proposed that the next session of the FAO Group on Coconut and Coconut Products be held in 1960.

* Members: Australia, Ceylon, Federation of Malaya, France, Western Germany, Indonesia, Italy, Netherlands, Philippines, Thailand, U.K. and U.S.A. Observers: Dominican Republic, Guatemala, Mexico, Nicaragua, Norway, Portugal and Viet-Nam.

Tropical Crops

A symposium of particular interest to those who have overseas connections has been arranged by the Agriculture Group of the Society of Chemical Industry for Tuesday, 12 May, at 14 Belgrave Square, London. The papers to be given cover the manuring of coconuts, coffee, oil palms and sugar-cane. Although the meetings of the Group are private, members may introduce visitors.

The Cultivation of Citrus

1—The Management of Citrus Lands

PROF. H. D. CHAPMAN

(Department of Soils and Plant Nutrition, University of California, U.S.A.)

Fig. 1 A navel orange tree which has been growing for 15 years as a water culture. Its healthy growth implies that there is no basic need for organic additions

We are privileged to publish this important statement, based on the wide experience of the author and on the work done at the Citrus Experiment Station, Riverside, California. The article will appear in three parts: (1) soil management; (2) irrigation and drainage; (3) correction of nutrient deficiencies. It is, indeed, a challenging and informative article which should be closely studied by agronomists and all who are engaged in the raising of tree and bush crops.

A QUESTION frequently asked is: What kind of soil is best suited to citrus production? The usual answer is that a uniform, moderately level, deep, loamy and well-drained soil is best; it should also be slightly acid and devoid of marked profile variations.

Actually, if climatic conditions and management are suitable, highly successful citrus production can be carried out under a wide range of soil conditions; texturally, from almost pure sands to clay adobe soils; depthwise, on soils underlain by hardpan or rock at 18 to 24 in., or even where there is a static water table at 24 in. Excellent citrus can be found on soils ranging from acid types (*p*H 4.5) to those containing free lime. The important point, and the one to be stressed here, is that, while successful citrus production can be achieved under a wide range of soil conditions, it usually requires special circumstances of climate and/or management to succeed with difficult soils.

Successful production of citrus on the sands of Florida is possible only because (1) there is sufficient rainfall, coupled with temperature and humidity conditions which tend to limit water stresses, (2) a fertiliser programme which supplies all needed supplemental plant food elements, plus a soil condition favourable to fertiliser availability and movement, and (3) favourable aeration and drainage. In the semi-arid climate of California, and despite supplemental irrigation, high-producing orchards are rarely found on sandy soils comparable in texture to the Florida sands.

Because of the sensitivity of citrus to over-moist soil conditions and its sensitivity to alkali salts, soils of moderate depth, intermediate in texture, and of slightly acid reaction, are likely to be, on the whole, more trouble-free and less in need of exacting management than some of the more extreme types mentioned.

Tillage and weed control

Tillage operations used to be considered essential for weed control, moisture conservation, soil aeration, nitrification and biological activity generally and, of course, indispensable for the incorporation into the soil of organic manures and fertilisers. It is now recognised that tillage sometimes does more harm than good. In the early days of citrus culture in California it was common to deep-plough orchard soils once or twice a year, to disk and/or harrow after each irrigation, and to furrow out for each successive irrigation.

The net result was the rapid development of a compacted layer at plough depth and the destruction of granular structure in many soils. This compacted layer or 'plough sole', coupled with structural deterioration and decreased air and water permeability, led to salt build-up (with irrigation) and the disappearance of roots in the cultivated area. All of this led to tree deterioration.

The non-cultivation technique

Recognising the ill effects of tillage operations, a few progressive growers initiated some years ago the practice of complete non-cultivation. They controlled weeds by herbicides or by hand-hoeing. The favourable effects on tree vigour of this change over prompted many growers to adopt this practice. In short, provided weeds can be satisfactorily controlled, *there appears to be nothing basically necessary or beneficial about tillage so far as tree health is concerned. In California the practice of non-cultivation has now been widely adopted.*

In newly planted orchards, where weeds are usually a serious problem, it is usually not economical to initiate non-cultivation at the outset; however, in these early years it is possible to keep tillage operations down to a minimum by the intermittent use of herbicides. This lessens the frequency of tillage, and if an occasional application of organic matter is made or a cover crop is grown the ill effects of tillage can be largely prevented. Under this partial system of weed control by herbicides it usually becomes possible to go completely over to non-cultivation after about five years. By this time weed seed has been substantially reduced and enough foliage is produced by the orchard planting, particularly if double planting is practised, to give sufficient shade to keep down weed growth.

When irrigation is practised, soil should be made as level as possible by the use of a drag, which is also used to construct wide-bottom furrows. Broad furrows are preferable to the V-type, for the accumulation of leaves and debris in furrow bottoms produces local pooling of water and difficulty in getting water through to the furrow ends; with broad furrows the irrigation stream is not so much impeded. Under non-cultivation it is necessary to do some cleaning out of furrow bottoms and to keep the furrow sides in repair. These operations become a regular part of the irrigator's job.

Economical weed control from this point on is best obtained by the use of herbicides, spraying when young, and most important, of course, preventing weeds from going to seed. In this process the judicious use of the hoe can be very advantageous. Petroleum oils and oil emulsions are still commonly used as herbicides in California. These are commonly fortified with toxicants to get a better kill. Killing weeds when they are growing is the best practice.

Perennial weeds, however, often require repeated spraying. The plant hormone 2,4-D is commonly used where bindweed is a problem. Dosage is from 12 to 16 oz. per 100 gal. of spray and it is suitable for spot spraying. Newer herbicides are now being recommended. Monuron (CMU) is the herbicide employed. At 2 lb. per acre, spread evenly in an aqueous spray and leached into soil by rainfall or sprinkler irrigation, it affords control for periods of two to eight months, according to information supplied by Boysie Day (*California Citrog.*, 1957, **42**, 415, 428, 430). Uniform application is essential, as otherwise there may be root injury. This spray should not be used in deciduous orchards or in young citrus orchards.

Fig. 2
Orchard-heating methods in California. The wind machine mixes the warm air above the trees with the cold air at ground and tree level to raise the temperature among the trees from 2° to 6°F. The oil-burning air heaters are used when the air temperature is exceptionally low

Dalapon at rates of 10 to 20 lb. per acre will control Bermuda grass, but there is some danger to the citrus roots, and growers are urged to wait before using this for further experimental results.

Organic matter applications

Because the incorporation of organic matter into orchard soils has been widely practised, growers frequently ask: Is it safe to discontinue organic matter additions? No final answer can yet be given, but, since one of the chief effects of organic matter is to counteract the structure-destroying effects and compaction incidental to tillage, the discontinuation of this practice correspondingly decreases the need for organic matter additions.

Whatever the final answer, Californian citrus orchards have been maintained in a highly thrifty condition for 20 years, and longer, with no additions whatsoever of organic materials save that of leaves and twigs from the trees themselves. Though some investigators may not accept this, *the author is convinced there is no basic fundamental need for organic matter in soils, provided the plant food requirements are satisfactorily met, soil permeability and aeration remain good, and moisture relations can be maintained satisfactorily.* The author has grown citrus trees continuously in water cultures for 15 years and maintained them

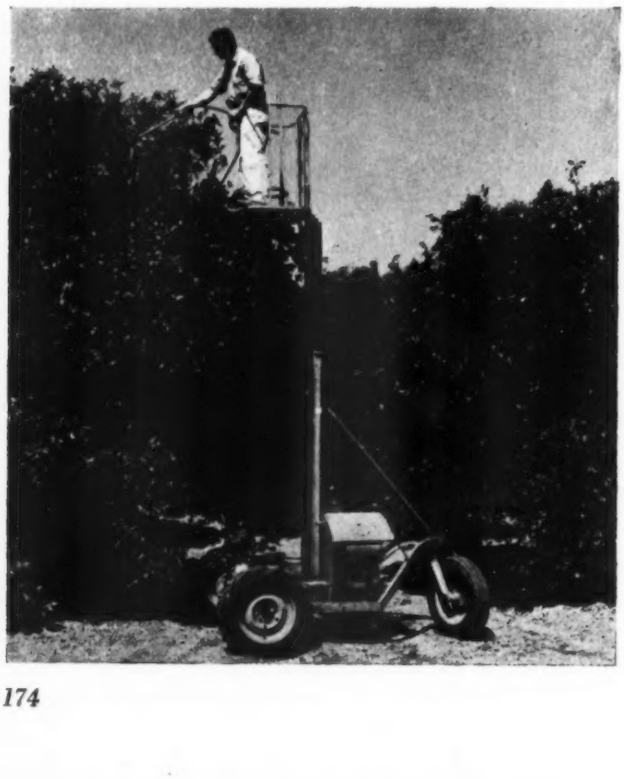


Fig. 3
A motorised tricycle unit used for the pruning of citrus. The tower can be raised and lowered and the machine moved from tree to tree by controls on the platform. Pneumatic pruning shears are also used

in a healthy state – no organic matter having been added (see Fig. 1).

Maintenance of soil permeability

Initial poor permeability characteristics of a soil, coupled with the permeability-reducing effects of irrigation, tillage, traffic and fertilisation, represent important management problems. The soil changes responsible for permeability reduction are usually confined to the surface 6 in. of soil and, as stated earlier, are of two kinds: first, the development of a compacted layer, beginning usually at 4 to 6 in., commonly referred to as 'ploughsole'; and secondly, the breakdown of granular structure. Sandy loam, loam and heavier types are especially prone to both of these.

Ploughsole results primarily from tillage operations, whereas structural breakdown results, not only from soil stirring, but also from chemical changes of various kinds. Decreases of soil organic matter result from oxidation processes, which in turn are accelerated by cultivation. Loss of organic matter causes soil granules to disintegrate owing to the disappearance of organic cementing agents. The use of irrigation waters containing too much sodium, calcium and magnesium displaced from soil colloids can cause soil dispersion. If the surface soil becomes too acid through the continued use of acid-forming fertilisers, such as ammonium sulphate, some breakdown of soil granules may occur. Sometimes a change over from a reasonably saline water to a water of very low salinity will, through the reduction in salt content of the soil solution, produce deflocculation. All of these, either singly or in combination, can bring about adverse structural changes.

One of the more common corrective measures is the incorporation of manures or bulky organic materials in the soil. In the low organic content soils of semi-arid regions it has become an axiom that, if cultivation is practised, it is necessary periodically to incorporate organic matter into the soil. In the decomposition of organic materials soil organisms produce organic cementing agents which flocculate the soil. Additionally, organic matter has a mechanical action in producing better soil tilth and increasing permeability.

Where soils have absorbed too much exchangeable sodium, or where the soluble salt content of the soil solution has become too low through the use of very pure waters, applications of gypsum will frequently cause substantial improvement in soil permeability. Rates of application vary from one to four tons per acre. For a sandy loam type one to two tons per acre usually suffice. Sometimes marked improvement in water absorption can be obtained merely by dumping bags of gypsum into the irrigation water or the use of crude gypsiferous minerals. Where gypsum is added to the soil at fairly heavy rates repeated doses at two to four-year intervals usually suffice.

When soils have become very acid (*p*H 4.5 or lower) it may be desirable to add limestone. Rates of from one to four tons per acre represent ranges commonly used on sandy loams or heavier types.

Another common method of improving soil permeability is to adopt the practice of non-cultivation. This has been discussed earlier. It suffices to say here that the discontinuance of ploughsole-forming, compacting and structure-deteriorating tillage operations enables natural structure-forming processes to gradually gain dominance. Improvement in permeability can be accelerated by the application of surface organic mulches. These mulches encourage earthworm activity and other macro-organisms which tend to loosen up the soil surface and also, through wormholes, gradually cause the ploughsole to be broken down. Also, the natural swelling and shrinkage of soils due to water application and loss, and root growth all work in the direction of restoring granulation.

Erosion control

In the management of orchard soils it is important, both in original layout and in operation, to consider soil erosion. Contour planting accurately laid out with respect to slope, terracing, basin irrigation, provision for surface run-off by sub-surface drains at the ends of irrigation runs, the use of cover crops or other ground cover, surface mulches and the practice of non-cultivation are all methods by which erosion can be minimised. Obviously, each particular situation will call for the method best suited to that individual case.

Soil fumigation

Under certain orchard conditions, not yet properly understood, an adverse biological flora develops. Both nematodes and various fungi are involved. At present there is no known chemical which can be applied to *existing* orchards which will control the adverse organisms without harming

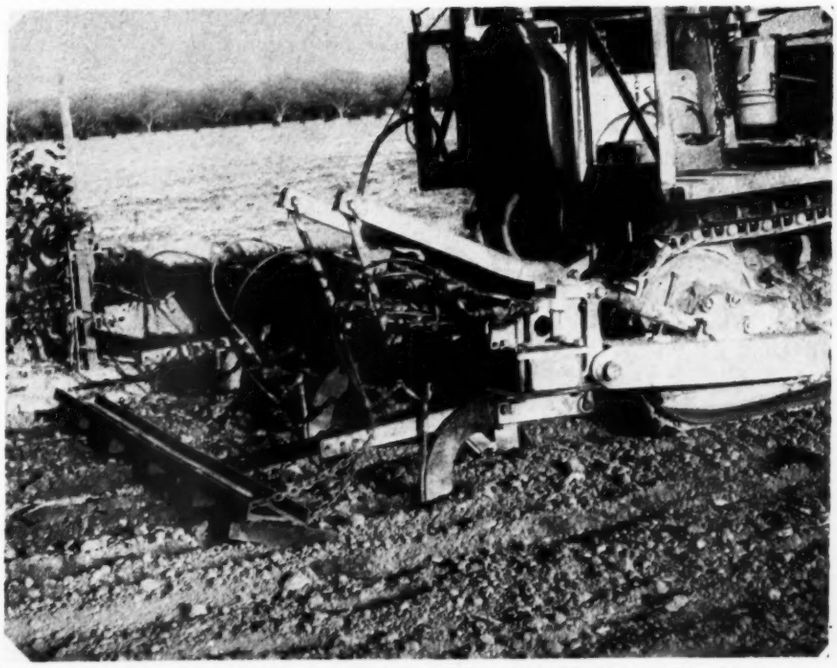


Fig. 4. Tractor attachment used for large-scale soil fumigation. The fumigant is delivered through tubes behind the chisels, and the drag which follows closes in and seals the fumigant in the soil

the plant roots. However, an intensive search is currently under way to find or develop such chemicals.

In replanting old citrus orchards where a detrimental flora has built up it is now a common practice to fumigate the soil. The best results to date have been with the compound known as Shell DD applied to small areas by means of a hand applicator or to large areas by special machinery. Depth of injection ranges from 10 to 18 in. and at rates of from 300 to 1,200 lb. per acre. The rates of application depend on the nature of the soil and its holding capacity for gases – coarse soils requiring less than heavy soils. This should be followed by a light irrigation to seal the soil surface and reduce evaporational losses of the fumigant. In California winter fumigation appears best from the standpoint of reducing volatilisation losses, and it is commonly recommended that planting of young citrus trees be deferred for at least six months and some growers wait a year, planting a shallow-rooted crop in the interim.

(*To be continued*)

Aerial Spraying of Rice

W. DAVIES-COLLEY, B.A.(CANTAB.)

There are obvious difficulties in the way of spraying fields of growing rice by means of knapsack and other man-borne sprayers, and an army of men and machines will be needed. The author suggests an alternative which makes it possible to complete the job safely and successfully.

RICE is the very basis of Indian and Asian civilisation and is the clue to a thousand troubles, political, social and economic, in the great re-emerging nations of the East. So long as any of these rice-producing nations is obliged to import rice it will be at the mercy of external shortages, distribution problems and political pressures; it must be weak and dependent, since the stability of its cash crops, such as tea, rubber, coffee and tobacco, ultimately depend on a cheap and plentiful supply of rice.

Each year an increase of one million tons of rice is needed solely to keep pace with the increase in population; and still one-third of the world's people live in semi-starvation. The enormous task of reshaping the economies of Eastern nations is now largely in the hands of their own governments, who have at their disposal a vast wealth of land and labour, and of modern technical knowledge. In view of the remorseless increase in population, this wealth must immediately be put to the best use.

One of the most promising means of increasing rice yield per acre is by the control of pests, particularly the stem-borers. Trials in India, Japan and the Republic of the Philippines proved that a high degree of control can be achieved by spraying insecticides, including endrin, and in these the increased yield easily outweighed the cost of insecticides and their application. But when, as in the Madras trials of 1954–55, one sprayer of the Fapperlot Rocker type and four labourers can cover only 4 acres per day, then large-scale operations are impossible without enormous over-investment in capital equipment.

One aeroplane of the Tiger Moth type, skilfully flown and with a good ground organisation, could, however, spray up to 1,000 acres per day; and aerial spraying is the only practicable means of controlling rice pests over a very large area of small fields. Though the cost per acre would be higher than with ground machines, it should still be possible to outweigh operational costs by increased yields and at the same time protect the whole of the acreage under this crop. For these reasons a new air-spraying company is to be formed whose chief aim is to develop the application of insecticides to rice in South-East Asia.

Endrin is a well-tried chlorinated hydrocarbon which has already been used from the air on other crops. Against rice pests the makers suggest one application in the seedbed and two in the main crop at dosages of 0.1 to 0.3 lb. per acre; it can be applied either as an emulsifiable concentrate with water or as granules or dusts. Timing is important and so are safety precautions. Careful reconnaissance of a particular area is necessary before spraying and the full co-operation of local authorities will be essential to ensure that men and livestock are not exposed to possible toxic effects, and for flood control to limit fish toxicity.

In areas of smallholder farming, only governments can finance operations on an extensive scale. The possibility is there: Western prosperity has been built on science and the use of the machine; the same can be done for Africa, India and Asia.

An enlarged photograph of the pupa of a rice stem borer Photo: Shell

* Aerial spraying contractor

Beating the Badlands

A Mechanical Monster for the Swamps of Africa

Buffaloes in tandem dragging a heavy baulk of timber from the forest bordering a Malayan rubber estate. The effective drawbar pull of these animals is only about a ton

In the November 1958 *issue there was an account of a unique swamp tractor of* 67 *h.p., designed for work in the peat bogs of Scotland and since used extensively in the forest swamps of Canada. Now there is a still larger version – an amphibian monster of* 150 *h.p. – to be used for exploring the steamy swamps of Nigeria.*

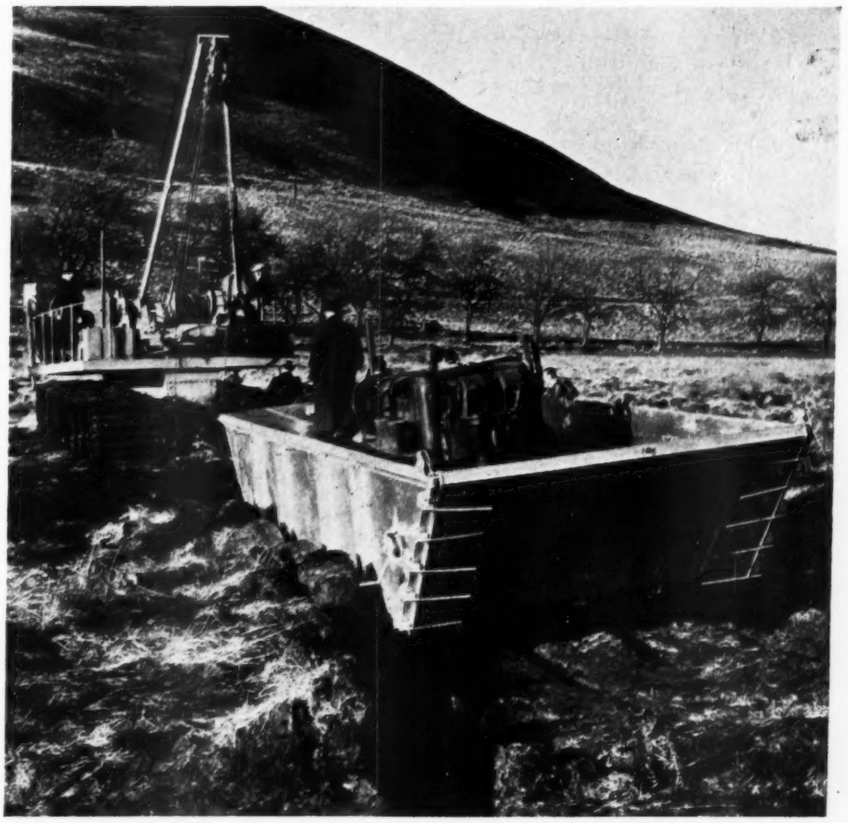
THE water buffalo, *Bos bubalis typicus*, is indigenous to India, Malaya and Ceylon. He is an amphibian who shelters from the noonday sun in his favourite ' wallow ' in a state of repose with only his nostrils showing. The bull is an immensely powerful and massive black brute with large sweeping horns, so strong that he is capable of overthrowing an elephant, and more than a match for a tiger, who generally declines combat. He will charge a man on sight, but when he is tamed and domesticated ' a little child can lead him '. He is usually employed for ' puddling ' the wet paddy fields or dragging heavy baulks of timber from the forest.

His principal characteristics – weight, power, bouyancy, low ground pressure and smooth under-belly – have been incorporated into the design of the latest *Albion-Cuthbertson* swamp tractor – the ' Water Buffalo '. The animal, who weighs perhaps a ton, can extricate himself from soft yielding mud because of his widely splayed feet; the mechanical monster weighs 25 tons, yet it exerts a ground pressure of less than 2 lb. per sq. in. It is thus able to operate in a quagmire of liquid mud, which would not support a man, whose effective ground pressure is 6.5 lb. per sq. in.

Then, again, a regiment of soldiers could not shift this gigantic ' Buffalo ' once he is firmly embedded in a wallow, but the *Leyland* 150-h.p. diesel engine with its easy-change pneumo-cyclic semi-automatic gearbox and automatic centrifugal clutch make it an easy matter for even a child to control. This mechanical monster is controlled rather than driven.

Purpose and description

The machine has been specially designed for the purpose of conveying heavy gear, engineering supplies, men



The 150*-h.p. ' Water Buffalo ', weighing* 25 *tons, drawing a loaded* 28*-tonner trailer barge through a quagmire. Its effective drawbar pull is* 38 *tons.*

and equipment deep into the heart of the impenetrable swamps of the delta of the Niger in the search for oil in what is probably the very worst terrain in the world for carrying out prospecting operations. The tractor will have to take in partially dismantled derricks, boring tubes and also special prefabricated steel platforms on which to mount the drilling rigs in swampy ground.

This unique tractor has a number of unusual features. First of all, it is mounted on two massive endless tracks to spread the weight and made up of narrow steel plates joined together by steel-reinforced rubber strips ½ in. thick; they travel over a number of independently-mounted and spring-loaded rollers. The tracks can flex freely in three directions – thus with the top half in tension the bottom runs free to mould itself to the contours and irregularities of the ground, so obtaining the maximum tractive power possible in the circumstances.

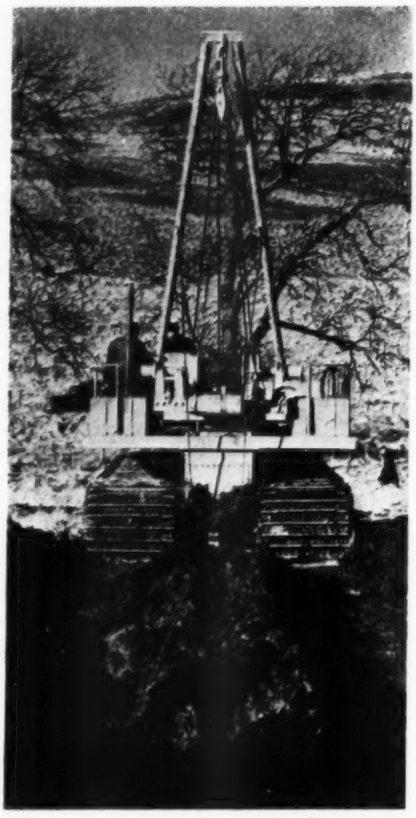
The second feature is the watertight under-carriage, which encloses all the moving parts except the track assemblies; thus the engine, the transmission and the steering gear remain dry even if the machine is operating in 4 ft. of liquid mud. The smooth under-belly of the hull also provides an excellent skid surface whenever the tractor has to winch itself out of trouble.

The third feature is the watertight steel extension to the superstructure, which converts it into a boat for operations in deep water. This extension is readily removable when not required. It is also equipped with two wheeled slipes or trailer barges, both of which have sufficient freeboard to enable them to float in deep water, even when fully laden. One barge is a 28-tonner and the other a 10-tonner.

The flat top deck carries a powerful capstan winch and reels of steel cable are provided for assisting progress in exceptionally bad places. A bulldozer blade, operated hydraulically, is fitted in front for carving a path through the undergrowth and trees. The 'A' frame at the rear for use as a crane can exert a line pull of 70,000 lb.

Passing out trials

Our representative was present at the passing-out trials of the first model, produced to the order of *Shell-B.P. Development Co. of Nigeria Ltd.* These trials took place on a broad stretch of peat bog in Scotland. The ' Buffalo ' was made to churn its way through half-frozen ground overlaying liquid mud and it gave a most convincing display.



The monster emerging from the morass after it had been deliberately made to settle down in the mud until its tracks were completely covered

In the first test it was deliberately made to settle down in a deep wallow of soft mud, so that its tracks were no longer effective and it could move neither backwards nor forwards. Then the tractor extricated itself quite easily, using the winch and cable, and liquid mud like porridge soon filled the hole. In this trial a convenient tree was used, but the machine also carries an anchor and anchor pins.

The next test gave an even more convincing demonstration of its power. An 8-wheeled barge, carrying a heavy tractor as a load, was pulled at an angle of 30° through the frozen morass against the side-resistance offered by the heavy balloon tyres of the loaded slipe. The ground over a wide area trembled and shook in protest, but the ' Buffalo ' prevailed and the immense load was dragged over soft wet, medium hard and frozen patches, without halt or hesitation, until it reached hard ground.

The final test was carried out on hard ground and consisted of a series of manoeuvres across and up the frozen and slippery surface of the hillsides. Its low centre of gravity and tremendous power were used to good effect.

Wider applications

The ' Buffalo ' swamp tractors were originally invented for the purpose of draining the Scottish peat bogs by cutting broad drainage channels through them some 2 ft. in depth. But they have far wider applications in world agriculture and forestry and for opening up otherwise impassable land for the passage of men and materials to virgin high lands in the interior. It would be an impossible task to build and maintain roads through miles and miles of deep swamp. This has been done in Malaya and in Ceylon, but only for short stretches of road and at a tremendous cost in filling and building and in subsequent maintenance. It would be an impossible proposition in the vast swamplands of the delta of the Niger, in the rain forests of the Amazon and the peat lands or muskeg of Canada.

The ability to get in is the essence of development work in swampland and secondary jungle, and a machine to draw an overall 68-ton load through muskeg, swamp forest and mangrove swamps without any previous preparation is a big step forward in the development of the under-developed and inaccessible regions of the world. The machine can cut a track through forested swamp at about 25 miles a day and at about one-tenth of the capital cost of road-making in swamp. It may well prove to be one of the significant inventions of the 20th century.

Cross-Pollination Device

An interesting cross-pollination device which may help fruit growers and plant breeders was demonstrated recently at a farmers' day meeting at the Cape Western Province Fruit Research Station, Stellenbosch, South Africa.

Selected pollen is collected and placed in a container, which is put in front of a beehive. The container is so designed that the bees returning to the hive cannot touch the contents, but as they leave they get dusted with pollen and carry it to the flowers of the fruit trees.

Highly productive country in Otago, South Island. Scotch thistles are to be seen in the pasture in the foreground

Weedkillers in New Zealand

CHRISTOPHER SAUNDERS, M.A.(OXON.), M.B.A. (HARVARD)
(*Fisons Pest Control Ltd.*)

IT is well known that New Zealand's farming is based on grass, for the growth of which it has in most parts of the country an excellent climate, with mild winters, adequate well distributed rainfall and summer temperatures that only in certain areas are consistently too high for ryegrass to grow.[1] In all parts of New Zealand stock are kept out of doors all the year round.

Table 1 gives a picture of the make-up of New Zealand farming, showing that sheep and cattle on grass are the major interest.

Small acreages of a wide range of different crops are grown; these include small grains, tobacco, peas, herbage seed, citrus fruit, peaches, sweet corn, potatoes, apples, apricots, and grapes. It is because of distance from large markets and the greater profitability of stock farming that the full cropping potential of the country has not been exploited.

New Zealand's weed problems and methods of control are quite close to those of the U.K. and the rest of Europe, but there are differences in emphasis that are most interesting. Some common weeds are listed in Table 2.

New Zealand is one of the leading countries in the world in the application of weedkillers to its agricultural problems. This is indicated by the reputation and long establishment of the New Zealand Weed Control Conference, whose 11th Annual Meeting was held in 1958.

Pasture weed problems

The very factors which have made New Zealand almost the ideal country for grass production also favour weed seeding and growth. Thistles are particularly troublesome.

In many districts, as a result of the drying winds of summer, pastures are usually opened out and bare by February. Then vast quantities of thistle seeds are blown from big areas of derelict land as well as from weedy pastures so that serious thistle infestations of pasture in the following spring are the rule rather than the exception. Where rainfall is over 35 in., ragwort, docks and buttercups are more important pasture weeds than thistles.

New Zealand's pasture weeds have been tackled with selective hormone-type weedkillers for a number of years, and techniques have gradually been refined. Dosage rates alone do not tell the whole story, as for many pasture weed problems, timing of spraying and management before and after play a considerable part, as they do in other environments.

The easiest weed, from the point of view of chemical control in established pasture is the Scots or spear thistle, *Cirsium lanceolatum*. It can be controlled from seeding up to pre-flowering stages, with from 0.5 to 1 lb. of 2,4-D or MCPA, or with 0.75 to 1.5 lb. of MCPB.

Californian or Canadian thistles, *Cirsium arvense*, are another problem, and the treatment is again similar to that common in other countries: 0.75 lb. of MCPA or 1 to 1.25 lb. of MCPB in late spring when the green buds show, but no purple colour, is the recommendation. Ideal timing may not be practical if biennial thistles are also present in quantity and have to be controlled as well.

Nodding thistle, *Carduus nutans*, is a more aggressive and difficult weed, seldom found in England, with a similar growth habit to the Scots thistle. It is not well controlled after the flower stalk has started to appear even by 2,4-D esters and it can germinate at any time of year. Significant numbers of nodding thistles do not die after seeding, especially if damaged by topping or trampling, and the following season these produce an early flowering cluster of rosettes off a big rootstock, very difficult to control with chemicals. Therefore if

an infestation of nodding thistles has been left unsprayed for a year or more, in the spring and summer there may be plants at almost every stage of development and so results from the first year's spraying are likely to be patchy.

The Nodding thistle problem occurs principally in the Mid and South Canterbury areas and North Otago in the South Island and Hawke's Bay in the North Island. Its seriousness can be judged by the fact that the thistles' rosettes can prevent dogs working sheep in a bad infestation and, later in the year when they are in flower, a horse often will not go through them. It is not surprising that farmers on the borders of the Nodding thistle area have proposed costly eradication methods to contain the weed. Typical commercial recommendations are spraying with 1 lb. MCPA or 1.12 lb. MCPB, in the rosette stage, in 10 to 15 gal. of water.

Finally, winged and variegated thistles are also troublesome, mainly on the eastern coastal hills. They are rather resistant to MCPA and MCPB, form dense large rosettes with fleshier leaves than the other thistles, and being truly biennial and the earliest flowering thistles, are prone to leave bare patches where the clumps have died out in the early summer. Reinfestation is only too probable in such places, if spraying is not followed by fertilising and oversowing.

Thistles are 'high-fertility' weeds, and the rapid improvement of New Zealand grassland in recent years has led to their becoming more and more of a problem. In much broken and steep country, aircraft have done the top-dressing and have also proved to be the only means of getting the spray to the thistles that follow pasture improvement.

Docks are a serious and increasing problem in pastures and where they have become well established in permanent pasture moderate control is obtained with 1.5 – 2 lb. MCPA per acre, at the cost of some damage to clovers. Some special esters of 2,4-D have also been used but they are very severe on clovers, which may well rule them out from the farmer's point of view.

Where possible the best way to deal with docks in New Zealand grassland is to plough-up and spray the subsequent cereal crop, if one is grown.

Scene on a farm in North Island. Around the horse's feet are winged and Scotch thistles, which, if not controlled, would reach up to its belly in a few months

Then, when the area goes down to grass again, spraying the young pasture at the recommended early stage of the clover with about 1.5 lb. of MCPB or 2,4-DB normally gives a good control of seedling docks.[2] This works particularly well in the North Island, where growing conditions are on the average rather more lush and weeds more susceptible than in the South Island.

Table 1

Summary of New Zealand agricultural statistics

Source: Pocket Digest of New Zealand Statistics

Area	104,000 sq. miles
Holdings:	
Over 10 acres	78,000*
Under 10 acres	12,400*
Unimproved, occupied land	23 m. acres†
Cultivated land:	
Total ..	20 m. acres†
Pasture ..	17.5m. acres†
Cereal crops for threshing ..	153,000 acres‡
Potatoes ..	22,000 acres§
Supplementary fodder crops for livestock ..	1.9m. acres§
Sheep numbers	42 m.§
Cattle ..	5.8m.§
Sheep and lambs slaughtered per annum ..	19 m.‡

* At 31.1.52
† At 31.1.55
‡ Year ending 30.6.58, estimated
§ Year ending 30.6.57

Ragwort is another difficult weed and it is generally found, as in England, that consistent results are not always obtained from spraying because of the different ages and therefore susceptibilities of the plants present in a pasture at any one time, and repeat treatments are required. 2,4-D ester at 1.5 lb. per acre gives the most satisfactory results, although at the cost of considerable clover damage.

The effect of hormone weedkillers on clovers, frequently mentioned in this article, has been the subject of some very interesting research in New Zealand. It has been shown by Lewis[3] that under certain conditions spraying ryegrass/white clover pasture at normally recommended rates (1 lb./acre) and times with 2,4-D and MCPA leads to a significant reduction in fat lamb production because of the reduction in clover giving less clover for grazing and making less nitrogen available for the grass. However, this was done with continuous set stocking of the sprayed area and controls, without the rest period that a farmer would often be able to give to a sprayed pasture. The result may be more extreme than a farmer would see, but it is nonetheless of considerable significance and interest. Other workers[4] have examined other aspects of the same problem and have also compared butyrics and acetics directly.

Stemming directly from such work has been the rapid acceptance of the butyrics, MCPB and 2,4-DB for spraying of both established and young pasture in New Zealand because they do not harm clovers, although these chemicals are more expensive and less potent weedkillers than MCPA or 2,4-D. The principal weeds of young pasture where they are especially used are fat hen, seedling docks, creeping thistle and wild turnip.

Crop weeds

The spraying of crops in New Zealand is similar to the standard practice in the U.K. Typical recommendations on cereals not undersown are ½ to 1 lb. of MCPA or 2,4-D depending on the weeds. As the acreage of cereals is comparatively small and there are seldom more than two years of cereals in a five- or seven-year rotation, the build-up of hormone-resistant weeds, which has been such a problem in England, has hardly occurred at all.

Thus Cleavers are widespread as hedge-row weeds but apart from headlands are seldom found in the body of a field. Polygonaceae are aggressive in some areas but as yet farmers have been willing to accept a moderate control and possibly some yield suppression from spraying with 2,4-D ester or amine.

In certain parts of New Zealand, particularly near Christchurch, Nelson and Hastings, peas for seed and for canning and freezing are an important crop. As in England they were notoriously dirty before the advent of the modern weedkillers but now are almost all sprayed for weed control with DNBP at 0.6 to 0.8 lb. per acre or MCPB at 1.25 lb. MCPB is preferred where Creeping Thistle and Prince of Wales Feather are the main weeds, although the position is now complicated by the uncertainty about pea flavour effects through this chemical.

Processors are cautious and cannot accept any risk though some unpublished tests have shown no effects. It is therefore likely that DNBP use in New Zealand will increase again despite its drawbacks of toxicity to man and a rather narrow margin of selectivity.[5]

Lucerne can perhaps be fairly regarded as a crop, being usually cut for hay although grazing with sheep is on the increase. It has an important place in New Zealand, being sown principally in the districts where droughts of a few weeks in free draining soils often sharply reduce production of grass. The area of lucerne is now about 100,000 acres. Fat Hen, Creeping Thistle and seedling docks in seedling lucerne can be satisfactorily controlled with 2,4-DB but Nodding thistle, established docks and other perennials in established lucerne do not seem to be well controlled by 2,4-DB, which, in any case, tends to damage established lucerne more than the young plant. Most grasses are adequately dealt with in lucerne by Dalapon, proved rates being 4 to 7½ lb. of the commercial material in early spring.

Scrub weeds

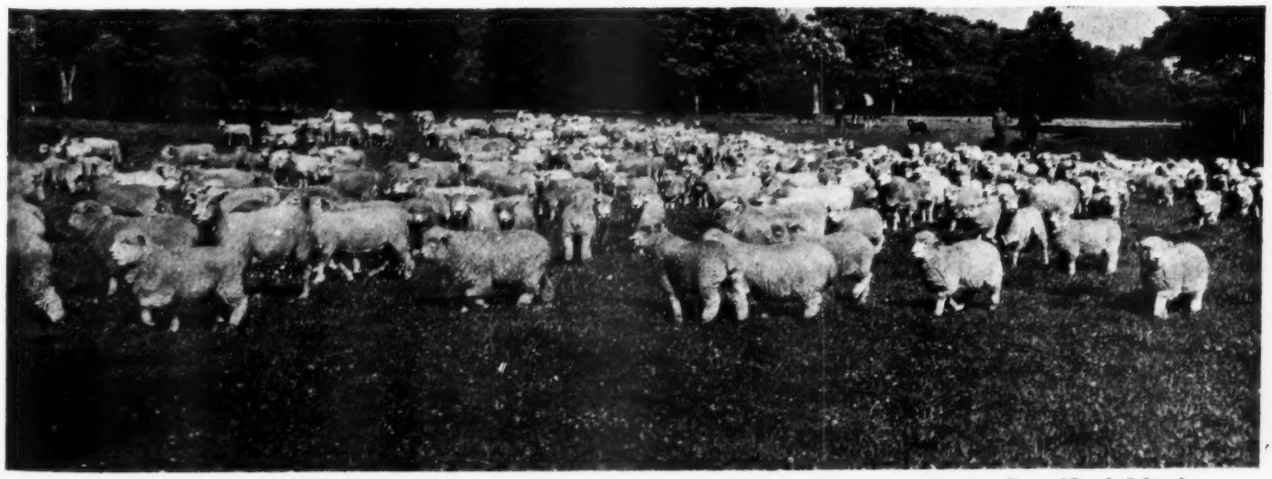
On a different scale to the pasture weeds, introduced shrubs or woody perennials have adapted themselves very well to New Zealand conditions and proved even more aggressive than in their native habitats. These include gorse, broom, sweet briar and blackberry, all of which cover tremendous areas of second class and marginal land and always threaten tens of thousands of acres of productive country.

The rate at which these plants have spread in the period of just over a hundred years since New Zealand development began is remarkable. As is so often the case, the weeds were given a start by man, for reasons that seemed good at the time. For example, gorse was one time sown as it did provide with little labour some grazing for sheep in dry summer weather before grass management, improved grasses and clovers, and supplementary food cropping were well understood. In addition it has been, and still is, widely used as a hedge; it makes an excellent hedge but one that can seed prolifically into pasture and on to the wide New Zealand road verges.

Grazing deals with gorse seedlings in all but the worst-managed pastures, except in gullies and broken ground where sheep do not graze intensively. Road verges on the other hand, little disturbed by droving nowadays as sheep are usually transported by trucks, develop a thick cover of gorse several feet high in a few years.

Sweet briar is a rapidly increasing weed in dry high country areas. Its spread has become much more serious since the virtual elimination of rabbits in the past few years. Evidently the rabbits kept the briar in check but they were a major pest in themselves.

Briar is particularly troublesome



A good ryegrass and clover pasture being grazed by ewes and fat lambs on a farm near Hawkes Bay, North Island

In the tussock country in South Island. Nasella tussock is a rough unpalatable grass, which covers vast areas of hill country and is spreading. The mountain is New Zealand's highest – Mt. Cook

because of the amount of grazing that it keeps sheep off and because it is hard for sheep to extricate themselves once they have been caught by briars. It thrives on country worth only a few shillings per acre and it is hard to justify any expenditure on control measures by individual farmers. Co-operative methods appear to be the only answer, when the area of clean land being protected from infestation is taken into account.

2,4,5-T ester formulations are the normal treatment for most scrub weeds at 3 to 4 lb. per 300 gal. of water, applied by farmers or contractors using high pressure (200 – 600 lb./sq. in.) pumps and variable nozzle hand guns, sometimes working with several hundred feet of hose. Complete coverage of gorse and broom is the aim, and up to 600 gal. goes on per acre. From spring to early autumn good control of gorse is obtained; broom should be done before Christmas (mid-summer) if possible, blackberry afterwards. There is a possibility of regrowth of all the species, more especially blackberry and sweet briar. So far, sweet briar control with 2,4,5-T in water is not sufficiently reliable, and using oil as a carrier has not been acceptable to the farmer because of its cost.

Special problems

Among the lesser uses of spray chemicals in New Zealand, clover defoliation with dinitro formulations is of great importance to some farmers and is becoming a standard practice in seed-growing areas. Even with New Zealand's sunshine it offers real advantages in improving the reliability of the clover seed harvest.

There are a few special weed problems in New Zealand where the Department of Agriculture is working to restrict or eliminate infestation of introduced plants. Cape Tulip, *Homeria collina*, and Water Hyacinth, *Eichhornia crasspipes*, are being energetically tackled, in the early stages of build-up. The problem here is not that control is particularly difficult in the light of present knowledge but that a really intense effort, that is very expensive per acre of infestation, is essential if a major national problem is to be avoided.

A new development which may become very important in New Zealand's continuous programme of upgrading pasture is so called chemical ploughing. Under experimental conditions in some parts of the country Dalapon has shown that it can reduce or kill the existing grass in a pasture sufficiently to allow over-sown or sod-seeded new pasture to become established. A somewhat more aggressive but non-persistent grass-killer would give even better results. Amino triazole has been tried.

Dalapon and TCA can also be used to control Nasella tussock, a rough unpalatable grass, that has taken over big areas of hill country and threatens much more. The problem here is more one of organisation than technique because it may be necessary for one farmer's land to be sprayed with considerable quantities of expensive chemicals in order to protect his neighbour's. Some progress is now being made through local Control Boards comparable to those set up for rabbit destruction.

Industrial and municipal weed control is also developing in New Zealand, with chemicals such as sodium chlorate used on railways and gravel footpaths and now CMU and the triazines. It appears that New Zealand's lush growing conditions and the high cost of labour will lead to further rapid expansion of this branch of weed control. Local authorities, for example, are already doing chemical weed control work on a wider scale than their opposite numbers in England.

Application methods

The great majority of agricultural chemicals applied to farm land go through ground spraying rigs made up from proprietary components and fitted on all sorts of tractors and trucks. Since pasture weeds are their main business many spraying contractors can use 30-cwt. trucks, carrying a 200-gal. tank, and spray at up to 12 m.p.h. They are usually equipped with high pressure orchard-type pumps to which they can fit adjustable nozzle handguns for scrub spraying, often the most important part of their business. Speed of operation is a prime consideration.

Farmers who do their own spraying normally have less elaborate equipment than their counterparts in England, no doubt because complete outfits, suitable for the three-point linkage of a tractor, are very expensive in New Zealand and cannot be economically imported. Their general interest in scrub spraying means that farmers now prefer pumps that can give about 5 imperial gal. per min. at up to 250 lb. pressure to the gear-pump type.

With the considerable development of aerial fertiliser application in New Zealand, it is natural that aerial spraying is also being introduced.

Until recently this was only a part-time activity for many top dressing companies but development has accelerated rapidly with the introduction of a number of helicopters which are used almost entirely for spraying.

Their work has been pasture and crop weed control in considerable areas of scrub. The scrub spraying is particularly interesting because it is being found that helicopters applying 1 gal. of 2,4,5-T formulation in 40 gal. of water per acre can on occasion give as good a result as ground hand-gun application of several hundred gallons of mixture per acre. However, results are not completely consistent and no doubt further development will improve this method of attack, which is particularly useful in the steep or rather inaccessible areas which make up a big proportion of the scrub-infested acreage.

Remaining problems

So far chemical weed control has made great strides but there are a number of problems where it is reasonable to expect that eventually a much better standard of results will be obtained. To cite a few, New Zealand needs a reliable chemical control of sweet briar, a gorse and broom killer that does not depend too much on complete cover for good results, a more potent thistle killer that is no harder on clover than MCPB, a better control of perennial non-grass weeds in lucerne and a grass killer that will select out reliably seedlings of barley grass from rye grass pastures. All these jobs are being tackled with chemicals, some with comparatively satisfactory results, but there is room for improvement in efficiency that would help towards a greater and even a lower cost farm production.

Progress in the application of chemicals to weed control in New Zealand is so rapid that this review cannot be exhaustive and it may be out of date on some points. There is, however, no doubt that New Zealand will continue to contribute a great deal to our knowledge of chemical weed control techniques in the future.

Table 2
Some common weeds in New Zealand

New Zealand name	*English name*	*Botanical name*
Established Pasture		
Barley Grass	Same	*Hordeum murinum*
Buttercups (annual and perennial)	,,	*Ranunculus spp.*
Daisy	,,	*Bellis perennis*
Dock, broadleaved	,,	*Rumex obtusifolus*
,, curled	,,	,, *crispus*
,, fiddle	—	,, *pulcher*
Nassella tussock	—	*Nassella trichotoma*
Ragwort	Same	*Senecio jacobaea*
Rushes	,,	*Juncus spp.*
Storksbill	Common Storksbill	*Erodium cicutarium*
Thistle, Californian	Creeping Thistle	*Cirsium arvense*
,, Nodding	Musk Thistle	*Carduus nutans*
,, Scotch	Spear ,,	*Cirsium lanceolatum*
,, Variegated	Milk ,,	*Silybum marianum*
,, Winged	Slender-headed Thistle	*Carduus tenuiflorus*
Crops and Young Pasture		
Black nightshade	—	*Solanum nigrum*
Californian Thistle	Creeping Thistle	*Cirsium arvense*
Chickweed	Same	*Stellaria media*
Cornbind	Black bindweed	*Polygonum convolvulus*
Docks	Same	*Rumex spp.*
Fat Hen	,,	*Chenopodium album*
Fumitory, Pink Weed	,,	*Fumaria officinalis*
Pennycress	,,	*Thlaspi arvensis*
Prince of Wales Feathers or Redroot	—	*Amaranthus spp.*, mainly *retroflexus*
Red Dead Nettle	Same	*Lamium purpureum*
Redshank or Willowweed	,,	*Polygonum persicaria*
Scarlet Pimpernel	,,	*Anagallis arvensis*
Shepherd's Purse	,,	*Capsella bursa-pastoris*
Speedwell	,,	*Veronica arvensis*
Spurrey or Yarr	,,	*Spergula arvensis*
Twin Cress	Lesser Swine Cress	*Coronopus didymus*
Tare, Vetch	Common Vetch	*Vivica sabiva*
Wild Turnip	Same	*Brassica rapa, spp. campestris*
Wireweed	Knotgrass	*Polygonum aviculare*

REFERENCES

1. Van't Woudt, Bessel D., 'Recent Advances in the Irrigation of Pastures in New Zealand', *World Crops*, 1958, **10**, 214.
2. Merry, D. M. E., 'Weed Control in New Pastures', *N.Z. Journal of Agriculture*, November 1958, **97**, 5.
3. Lewis, K. H. C., 'The Use of Weedkillers in relation to Fat Lamb Production', Proc. N.Z. Weed Control Conference 1956 and 1957.
4. Maclean, S. M., 'Effect of Time of Spraying on Pasture Production', Proc. N.Z. 10th Weed Control Conf., 1957. Edmond, D.B., 'The Spraying of Established Pastures', Proc. N.Z. 10th Weed Control Conf., 1957.
5. Allen, F. C., 'Chemical Weed Control in Peas', Proc. 9th N.Z. Weed Control Conference, 1956.
6. Fitzgerald, J. N., 'Weed Control in Lucerne', Proc. 10th N.Z. Weed Control Conference, 1957.

General. Matthews, L. J., 'Chemical Methods of Weed Control', N.Z. Department of Agriculture Bulletin No. 329.

Photos: High Commissioner for New Zealand

Tropical Products Institute

The Tropical Products Institute (Director: Dr. R. A. E. Galley) has become one of the research stations of the Department of Scientific and Industrial Research.

The purpose of the Institute is to assist in the economic development of the under-developed territories of the tropics, but primarily those that form part of the Commonwealth. The aim is to improve the technology of already existing industries and to introduce new industries as a result of research into new uses for tropical plant and animal products, including the waste products of existing industries. Particular attention will be directed to the needs for diversification in those territories which have a one-crop economy.

Nitrogenous Mud

Mud from Lake Bangweulu, in the Northern Province of Northern Rhodesia, is to be tested to see if it can be used as a nitrogenous fertiliser. Analysis has already shown that the mud contains $2\frac{1}{4}\%$ nitrogen, which is the equivalent of 250 lb. of sulphate of ammonia per ton. The mud is apparently derived from countless generations of small water organisms.

The Profitable Use of Fertilisers

Under the auspices of the National Agricultural Advisory Services and the Fertiliser Manufacturers' Association a series of conferences have been held in Northern Ireland, South Wales and in the northern, eastern and southern counties of England

The ' Wild-Thwaites ' muck spreader is a tractor-mounted machine designed to spread heaps of manure over the land

IN his address on ' The Principles of Grassland Production ' at Carmarthen, **Prof. W. Ellison** (*Univ. of Wales*) pointed out that Wales was predominantly a livestock country in which ruminants, cattle and sheep, played the most important part. As a feed for these ruminants, grass was the cheapest of all foods available to the farmer, for as grazing it cost only about one-fifth of a balanced concentrate, and as hay or silage it cost only about one-third of a balanced concentrate.

Since grass was such a cheap food, it offered great scope to the farmer in helping to reduce the costs of production of cattle and sheep products. This was particularly true of milk, since food costs account for about 60% of the total cost of milk production and rather a higher proportion than 60% in the case of beef and mutton.

The average yield of grassland in Britain he estimated to be about 15 cwt. of S.E.* per acre, yet on some farms, after allowing for the feeding value of the purchased foods and arable crops grown, the grassland was contributing practically nothing to milk production. Thus there was a wastage of feeding stuffs somewhere.

In contrast, farmers who are expert at grassland management have obtained anything from 100% to over 200% greater outputs than the national average from their grassland.

There were two main ways of increasing production: one was through the use of lime and fertilisers only; the other required the use of the plough.

What are the reasons why more farmers are not using more nitrogen? he asked. As he saw it there were two. One was the price and the other prejudice.

With regard to price, it had been shown that an average increase of 2 cwt. of S.E. per acre could be obtained from the equivalent of a dressing of 1 cwt. of sulphate of ammonia. The cost of such a dressing at current prices would be about 18*s.* and the value of the increased grass about 50s. So there could be no question of it being a paying proposition in the hands of the good farmer.

It was often said that the use of nitrogen decreased the clover and this could happen for one of two reasons: (*a*) Really large quantities of a nitrogenous fertiliser have been used, or (*b*) the pasture has not been properly managed.

He considered it most important not to let a pasture which had been dressed with nitrogen get away from the grazing animal, because the harm to the clover was mainly through overshading and being smothered out and not from any toxic effect of the nitrogenous fertiliser on the clover itself. Intensive grassland production through the use of fertilisers was a method which involved a balanced use of fertilisers and a fairly high standard of grassland management.

There was plenty of evidence that ploughing for better grass was sound. As regards seeds mixtures, it was important to sow good seed of the right species and strains to suit various

* S.E.: starch equivalent.

The David Brown-Albion manure spreader behind a 2D tractor

McCormick International manure spreader, No. 31, has a capacity of 95 bushels

conditions: timothy-meadow fescue mixtures were worth consideration because they had given good results in many parts of Wales; but he considered that the general-purpose mixture still had an important part to play in British agriculture.

Grazing management must aim at maintaining a balanced sward – balanced not only for the useful grasses, but also for white clover. The object of growing more grass was to increase the net farming profit. The important point was that more grass gave the farmer more scope in the size and scope of his farming operations. He could graze the same herd of stock on his land and conserve more grass for use in the winter, or he could keep more stock and divide the extra grass between winter and summer use.

The aim must be to keep the pasture in as active and leafy a condition as possible and especially to try to obtain more grass in July, August and October. In addition to grazing management, one way to do this was to put some more nitrogen on two or three fields after the first grazing or silage cut at the end of May or early June, and try to save them for use at the end of July and in August. Similar fields dressed with nitrogen in August will give increased production in October and the back-end of the year.

The overall consideration was to use the grass as economically as possible, and in this connection he considered that the electric fence has been one of the most valuable tools in grassland management.

In the old days fields were set aside for grazing and conservation; today the farmer should be prepared to take cuts for hay or silage off any area surplus to his grazing requirements. In this way areas which have been grazed intensively in the spring could be ' sweetened ' for grazing later in the season. It was worth remembering that the use of the electric fence can increase the effective grazing of an area by 30 or 40%.

There was certainly a place for both hay and silage on many farms. Whatever method was adopted, the important point was that the conservation of grass was a key factor in the proper utilisation of grassland production and every bit as important as grazing management.

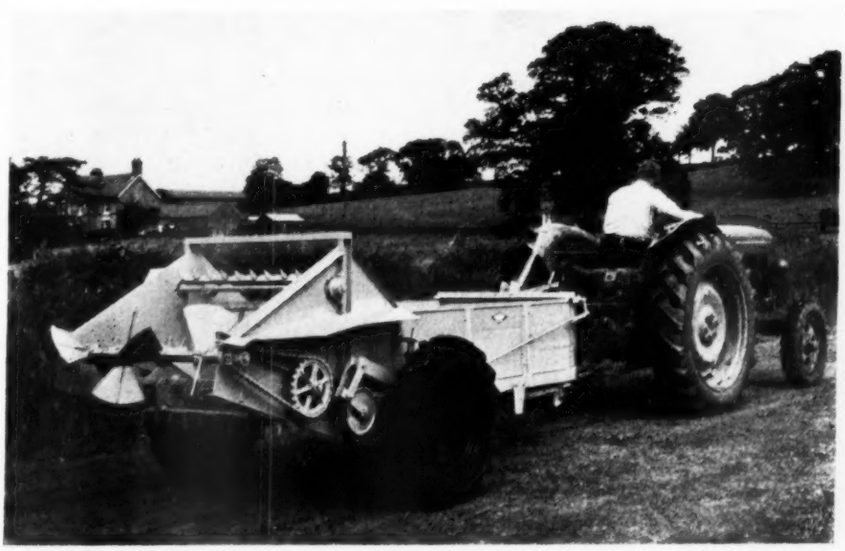
In conclusion, he said he was not against the use of purchased food, whether it was grown elsewhere in this country or imported from abroad, but what was bought should be complementary and in proportion to what was grown on the farm.

Speaking at Bedford, **Mr. Gemmill** (*Cambridge farmer*) said the secret was to treat grass as a crop. It was essential to ensure that soil conditions, including drainage and the lime status, were right and to fertilise regularly and adequately. On his own heavy land he put fertilisers on grass four times a year: first, a dressing of 3 to 4 cwt. of a phosphate-nitrogen mixture as early as possible for an early bite; after two grazings, 2 cwt. of sulphate of ammonia were applied in late May; and in July a dressing of a compound fertiliser, this time containing potash. At the end of September a further 2 cwt. of nitrogenous fertiliser ensured grazing into the autumn. As a result, stocking at his farm was three times as high as the average for the Eastern Counties of England.

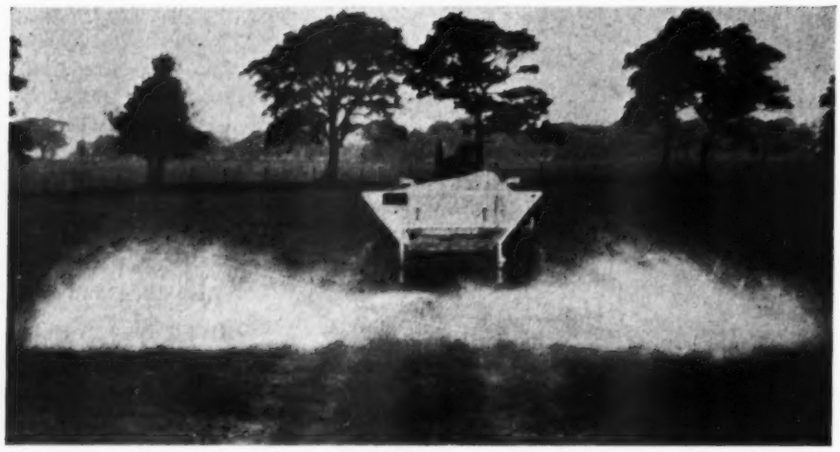
Continuous grazing was possible by using the right strains of ryegrass for spring growth and meadow fescue for summer use. By avoiding excessive nitrogen at one time there was no question of crowding out the Suffolk white clover which he used in all mixtures.

He gave some useful hints on establishing leys. A great deal could be done before sowing to ensure high production from lucerne, but little could be done after it was established. He favoured thorough cleaning to eliminate weed grasses, such as couch, with a good dressing of farmyard manure ploughed into the seedbed. On heavy land he found no benefit from potash in the establishment of lucerne, but recognised that it was usually necessary on lighter soils.

The importance of liming to obtain full value from fertiliser applications was stressed by another speaker, **Dr. N. H. Pizer** (*National Agricultural*



The S.K.H. ' Quickspreader ' on its way to work. The shredders and the distributor can be seen



The tractor-drawn ' Spreadall ' Mk IV has twin disks for spreading lime, fertiliser and similar materials

Advisory Service). Apart from making certain fertilisers more readily available, liming encouraged better root development, thus enabling the plant to take up more nutrients from the soil. Heavier crops would result and, since more nutrients would be taken out of the land, the demand for fertilisers by succeeding crops would naturally increase.

Describing various local soil types, he stressed the need for plenty of phosphate on Fen peats. There was also a danger of copper deficiency in these soils, he said.

The importance of a proper tilth to aid root development was often overlooked. Good cultivations were a first essential, but in a wet season bad weather after drilling caused many clay soils to run together and the tilth was lost. Where tilth might be damaged it would be advisable to put on all fertilisers, including nitrogen, in the autumn, so that damage by running over the land in the spring could be avoided.

Fertiliser placement was discussed by another speaker, **Mr. J. Procter** (*fertiliser manufacturer*). Even distribution was only possible at present by using combine drills or other placement devices. Spinners, though they had gained popularity recently, were not so successful. Trials had shown that grain yields were 3 to 4 cwt. higher when combine-drilled. Savings of fertilisers were also possible; potatoes, for example, would need a broadcast dressing of 15 cwt. to the acre, whereas only 10 to 12 cwt. would be needed if the applied fertiliser was accurately placed.

He reminded farmers that one of the cheapest fertilisers is water. He said that where an irrigation system existed there was the possibility of applying nitrogen through it and this had a particular use in areas of intensive farming and market gardening.

Reviewing current trends in fertiliser use, he mentioned the increase in the applications of nitrogenous and potassic fertilisers. Use of phosphates had become relatively stable in recent years. Another interesting development was the addition of insecticides, weedkillers and trace elements to fertilisers.

There is no doubt that the judicious use of fertilisers can play an important part in stimulating farm economy, and there is still room for a considerable increase in their use.

In his address on the ' Profitable Use of Fertilisers ', **Mr. J. Webber** (*National Agricultural Advisory Service*) emphasised the value of organic matter and said that farmyard manure was still important, especially on lighter soils, for the maintenance of soil structure as well as for supply of plant foods. But with the decrease in horse numbers there was not enough to go round today. Although his talk was on fertilisers, it must be fully realised that, especially for root crops, farmyard manure supplies appreciable amounts of plant foods and its use must be taken into consideration.

There has been a big increase in recent years in the use of fertilisers.

He pointed out that there had been a large increase in the use of nitrogen and potash and a small decrease in phosphorus. Much larger amounts of fertilisers were used in arable areas than on grass.

Farmers making larger profits from arable crops were generally heavy users of fertilisers, he said. Profit in farming, as in other business, depended on business ability. It was evident, however, that successful farmers found that the use of fertilisers pays, but high yields demanded a high standard of farming – not only manuring, but cultivation, use of good seed, varieties, weed, pest and disease control etc. Quality, however, did not always go with high yields. Quality was generally conceded to be desirable, but only rarely was the buyer prepared to pay an adequate premium for it.

In his address on ' Modern Techniques in the Application of Fertilisers ', **Mr. D. I. McLaren** (*National Institute of Agricultural Engineering*) speaking at Doncaster, Yorkshire, said that, from the farmer's point of view, there have been comparatively few major developments in recent years in connection with fertiliser distribution machinery. However, one outstanding feature has been a very rapid increase in the number of spinning-disk type distributors in use.

At the present time the most commonly used methods of applying fertilisers on the farm are by means of conventional fertiliser distributors – both of the full-width and of spinning-disk type – and of combine drills. Some of the other lesser used methods, such as band fertiliser placement, aerial application and the ground application of liquids by spraying or injection, he considered, may become more important as fertiliser manufacturing and crop production techniques develop.

Of the full-width machines, the *plate-and-flicker type of distributor* is now the most widely used. Variations in transverse distribution (across the machine) are up to approximately ± 50%† of the mean application rate with certain types of fertiliser, but ' peaks ' and ' hollows ' (*e.g.* areas of

Table 1
Use of fertilisers in the U.K.
(Thousands of tons)

Yearly average for period	N	P_2O_5	K_2O
1932–9	59.4	172.0	62.5
1940–5	152.5	283.0	82.0
1952–3	230.1	388.9	246.9
1954–5	248.1	334.6	274.1
1957–8	309.8	365.8	348.1

high and of low application rate) are so closely spaced that these variations are of little practical importance.

Variations in longitudinal distribution (in direction of travel) can be considerable over bumps or on slopes and in this respect the plate-and-flicker type of mechanism is inferior to some other types (*e.g.* reciprocating plate or spinning disk).

Spinning-disk distributors now on the market vary widely as regards evenness of transverse distribution. The best so far tested by N.I.A.E. had a minimum variation in transverse distribution of $\pm 20\%$ of the mean application rate, but 'peaks' and 'hollows' are often spaced yards apart with spinning-disk machines, as compared with a few inches in the case of plate-and-flicker full-width machines.[2] Most of the spinning-disk designs are, however, less sensitive to slopes or bumps than the plate-and-flicker types.

It was, he said, impossible for users to judge by eye the evenness of distribution, yet users were expected to assess width and evenness of spread by eye when setting their machines. Farmers do not always realise the importance of maintaining a constant disk speed and bout width; variation in bout width of 5 to 10 yd. was often seen in the field where markers are not used.

Combine drills have changed little since their introduction and were widely used. The star-wheel type of fertiliser-metering mechanism was the most common. Performance of this type of mechanism was usually acceptable, but the machine was sensitive to the form and condition of the fertiliser. The chief disadvantage of existing designs was that in many cases the fertiliser hopper was too difficult to clean and maintain.[1]

In view of evidence in favour of ***side-band placement*** with a number of crops (mechanically planted potatoes, peas and beans, horticultural crops as part of a farm rotation, and swedes grown on the flat),[3] it was rather surprising that relatively few machines for this purpose were at present available and that, where appropriate, this method of applying fertilisers was not more widely used.

Existing placement devices were mainly in the form of attachments to existing machines; some designs do not place the fertiliser in the most advantageous position. Difficulties associated with the design and construction at a reasonable cost of a 'universal' machine. Care must be taken in selection of the fertiliser-metering mechanism to avoid wastage and possible damage to germination or lowering of yield and a patchy crop.

The Webb wheel-driven 'Quicspread' fertiliser distributor for mounting on a tractor

† During the last two years the N.I.A.E. has been carrying out a series of tests o fertiliser distributors, and most of the performance data are extracted from published test reports and other related published material.

REFERENCES

1. Slater, J. K. W.: 'A Survey of Fertiliser Distributors and Combine Drills', *J. Agric. Eng. Res.*, 1957, **2** (4), 293.
2. Hepherd, R. Q., and Pascal, J. A.: 'The Transverse Distribution of Fertilisers by Conventional Types of Distributor', *J. Agric. Eng. Res.*, 1958, **3** (2), 95.
3. Cooke, G. W.: 'The Value of Fertiliser Placement', *J. Roy. Agric. Soc. Eng.*, 1957, **118**, 37. (Notes on the talk given by D. I. McLaren at the joint N.A.A.S./F.M.A. Conference on 'The Profitable Use of Fertilisers', held at Doncaster, January 1959.)

*Honduras**

Honduras, a Central American republic, whose economic problems have certain similarities to those of other Latin American countries, has the power and the potential to transform its economy in the next 20 years with wise development policies, a reasonable amount of foreign assistance and certain fundamental improvements. Literacy must be promoted, health problems solved, increased vocational and agricultural training provided, transportation improved, and new industrial and tourist possibilities explored.

In Honduras, as in most other under-developed countries, recent years have seen a change in attitude towards economic development. The very first prerequisite of a development programme, *i.e.* a desire on the part of the country's leaders to get on with the job, is not lacking.

Today, in 1959, Honduras remains predominantly what it was in 1821 – when it ceased to be a colony of Spain – a country which has made relatively little economic progress compared with the economic growth in the world as a whole. Neither the efficient banana industry, grafted upon the Honduran economy by U.S. capital early in the 20th century, nor the efforts of the Honduran Government since about 1950 to diversify and modernise the economy have as yet fundamentally altered the position.

Exports of bananas, upon which the economy is chiefly dependent, have, in fact, seriously declined. Despite this, the presence in Honduras of the United Fruit Co. and the Standard Fruit Co. is a tremendous asset. The net contribution by the fruit companies has been large and without this there would be little or no banana industry in Honduras today.

It is obvious, however, that one of the most important aspects in developing the economy must be the establishment of new industries to correct the over-dependence on the banana crop.

Fortunately, there is timber, for which there is a good and improving international market. The greater part of the country is covered by forest and the establishment of a pulp and paper mill is now under consideration.

Among the brighter prospects for Honduran economic development is that never before in her history has there been such an availability of foreign financial and technical assistance. Among U.S. Government institutions there are the Export-Import Bank, the Development Loan Fund and the International Co-operation Administration. International agencies include the International Monetary Fund, the International Bank for Reconstruction and Development, the International Finance Corporation and other organisations operating directly or indirectly under the United Nations.

**Honduras: A Problem in Economic Development* published by the Twentieth Century Fund, 1959

The famous Cactus Garden at Corona, Lower California. The plant in the foreground is the Creeping Devil, Machaerocereus eruca, *found only at Magdalena Bay in Mexico*

The Cactus

The Craziest World Crop

J. B. KEMMERER
(*U.S.A.*)

OF all plants, the cactus is the most contrary in the whole vegetable kingdom. It is probably the most bizarre, the meanest, the most tenacious and toughest to kill, and the most grotesque – a plant that assumes the most variegated and irregular shapes and sizes and yet produces the most sensuous and alluring flowers.

In size, colour and fragrance there is hardly a flower that can match some cactus blossoms. A single blossom of a night-blooming Cereus will perfume an entire *patio* (enclosed courtyard), and the flowers are sometimes 15 in. across.

It is possible to make a fortune by growing a plant which other people have spent millions of dollars trying to eradicate – the cactus – but it is also a hazardous business.

Wide distribution

The cactus has been called the camel of the desert, because of its impervious rind and drought-resistant characteristics; some varieties can withstand summer temperatures of more than 140°F, and yet others can endure winter temperatures colder than 20° below freezing (12°F). Many grow among rocks at altitudes of thousands of feet, where human habitation seems impossible, while others thrive at below sea level. Some are desert plants, others like the cold and some are even found in tropical rain forests.

In adapting itself to such varied and often rugged conditions cactus assumes many forms. About 150 different groups or genera, making up more than 2,000 varieties of species, are distributed throughout the American continents, even including Canada.

Nature and characteristics

The word ' cactus ' stems from the Greek word *kaktos*, meaning ' prickly plant '. The plants are easily recognised by their fleshy stems and branches, the leaves – in most cases – taking the form of scales or sharp spines. Although cacti are succulent plants, yet not all succulent plants are cacti.

Some adult cacti weigh 10 tons or more, while others are never larger than a small button. Many have razor-sharp spines shaped like fish hooks, some are like knitting needles, while others sprout spear-point spines a foot long. Often their monstrous yet exotic and fantastic shapes are known by expressive common names: goat's horn, old man, bearded man, boxing glove, powder puff, pin cushion, mule ears, baby toes, bow tie, burro's tail, mother-in-law tongue, and hundreds of others.

The cactus industry

No matter for what reason, the cactus has become an object of affection and near worship to thousands of collectors in all parts of the world.

The centre of the world's cactus industry is California and Texas, where some 30 companies are now engaged in the commercial production of cactus

and other succulents in gardens of up to 15 acres in extent. Howard Gates – the leading grower – first started his now-famous cactus gardens in 1930 in the foothills near Corona, California.

Most of his explorations in search of new varieties have been in Mexico and Lower California, where he has travelled far and wide. One variety, now widely distributed in private collections, originated from cuttings obtained from a single plant which he found on a mountain top in the wilds of Lower California.

Gathering the seed of Euphorbia obesa. *Each fruit contains three seeds and explodes when ripe. The plastic double cones catch the flying seed*

Multiplication from seed

He also reproduces cacti from seeds, which are literally worth their weight in gold, for the current price of seeds is over $40 per ounce of, say, 25,000 seeds, depending on the variety. He obtains some of his seed from expert collectors in Mexico, but the bulk of his supply is produced in his own garden, though this is a time-consuming and painstaking operation, the seeds being collected a few at a time.

The seeds are allowed to mature on the plants, but, unfortunately, when they are ripe the fruits which contain them explode and eject the seed in all directions. To prevent this loss of precious seed a plastic cone is placed over the plant to catch the flying seed.

Under natural conditions only a small proportion of cactus seeds germinate; to be successful a grower must reverse this and obtain successful germinations, but there are many hazards. The seed must be planted in fumigated or heat-treated soil to reduce losses due to pests, diseases and competition with weeds, and the seed-germinating boxes or 'flats' need to be kept in a greenhouse at a constant temperature of 70°F.

The Old Man of Peru, Espostoa lanata, *growing in ground beds in a netting shade house. The men use tongs for lifting them*

About six months after planting the seeds start to germinate and the surface of the flat is generally covered with hundreds of tiny plants. Unfortunately, sometimes only a few of the seeds germinate and the flat may be even less than half covered.

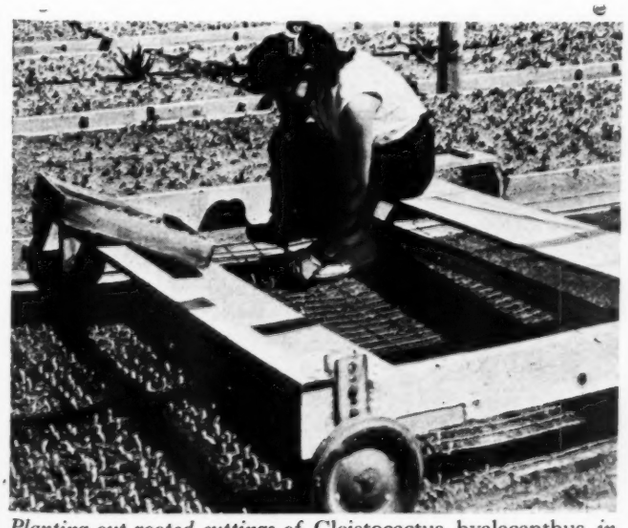
Now, it is necessary to lift the diminutive plants – one at a time – and replant them in flats holding 400 plants. Then as they continue to grow they are again transplanted to flats with still fewer numbers. Thus by the time they are of marketable size they will have had at least three transplantings.

Care and maintenance

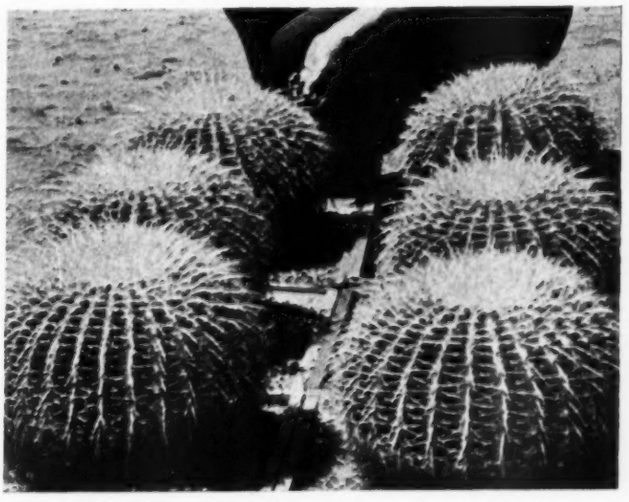
When they are ready for marketing, some are placed in lath-covered houses, still in flats and on concrete bars to give good drainage, while others are set out as cuttings in various lath- or net-covered houses. As with the flats, all ground used for cacti growing is fumigated, usually with methyl bromide, to kill pests, diseases and weeds.

Contrary to general belief, cacti can use a considerable amount of water, if it is available. This is especially true during germination and early growth. When the small plants begin to sprout they are given a thorough watering, twice a day, and even adult plants require weekly watering. Few will die from over-watering; the real danger lies in poor drainage, causing the roots to rot and thus destroying the plant.

(*Continued on page* 192)



Planting out rooted cuttings of Cleistocactus hyalacanthus *in a ground bed which has been fumigated with methyl bromide*



The Golden Ball cactus, Echinocactus grusonii, *after 25 years of slow growth*

Weeds in Temperate Regions—4

Special Weed Problems

The Eighth Session of the Fourth British Weed Control Conference at Brighton was devoted to special problems of weed control – the treatment of bracken and couch grass and the selective control of certain obnoxious grasses in grass seed and cereal crops.

Bracken, *Pteridium aquilinum*, is a dominant plant over considerable areas of the earth's surface, generally on light acid soils in both woods and grassland. It is a very persistent and troublesome weed, because not only is it normally avoided by grazing animals, but it is also capable of spreading very extensively by means of its underground rhizomes, and so destroying valuable pasture. A really cheap and effective herbicide to control it has yet to be found and hitherto control measures have mostly been based on mechanical treatments.

The control of couch grass, *Agropyron repens*, has until recently been dependent upon summer fallowing, allowing the rhizomes to be dried out and killed. This method can give very successful results in suitable seasons, but may be ineffective during wet summers. Repeated rotary cultivations have been shown to be effective for the control of heavy infestations, but the use of herbicides as an alternative treatment is receiving increasing attention.

Blackgrass, *Alopecurus myosuroides*, is frequently a troublesome weed in autumn-sown cereals and pastures on heavy soils. It is not only strongly competitive, but its seed is difficult and expensive to separate from grass and clover seed crops, in which it is a serious contaminant. Up to now no recommendation could be made for its control by chemicals and cultural methods alone have had to be used, *vide Weed Control Handbook*, p. 59.*

These were the three difficult subjects which were discussed under the able chairmanship of Prof. R. L. Wain (*Wye College*). The following is a very brief summary of the papers presented at this session:

Control of Blackgrass in Grass Seed Crops with Propham and CIPC *by R. S. L. Jeater (Plant Protection Ltd., Fernhurst Research Station)*

Greenhouse and field tests have shown that both propham and CIPC will control blackgrass at 3–4 lb. per acre, providing the chemical is applied before the three-leaf stage. At rates of 4 lb. per acre both these chemicals applied in October are relatively safe on seed crops of meadow fescue, cocksfoot and timothy in their second and subsequent harvest years, but from the limited work carried out it appears that there is danger of damage to the crop in its first harvest year.

The main trouble from infestations of blackgrass is in the first harvest year of grass seed crops, and hence the possibility of damage to the crop makes the technique of applying either propham or CIPC in October prior to harvest much too dangerous. The technique is, therefore, of very limited use for the control of blackgrass in grass seed crops.

The Effect of Propham and CIPC on Grass Seed Crops Sprayed in the Year of Sowing *by Lewis Jones (Grassland Research Institute)*

The experiment was conducted to examine the effect of propham and CIPC on inflorescence production in four grass species after spraying in the year of sowing. The chemicals were applied at rates of 3 and 6 lb. per acre on four dates in the autumn.

There was no effect with any treatment applied in September, but damage, greatest at the higher rates, occurred with October and November sprayings. Where heavy rain followed spraying, damage was greatly increased on all strains. When serious damage occurred, CIPC proved more toxic than propham on all species except cocksfoot. Ryegrass and meadow fescue were most susceptible to damage and timothy slightly more susceptible than cocksfoot.

The Effect of CIPC and Propham on Young Grass Seed Crops *by G. W. G. Briggs and D. H. Payne (N.I.A.B.)*

Both CIPC and propham applied at rates and times likely to control blackgrass can damage young grass seed crops under certain conditions.

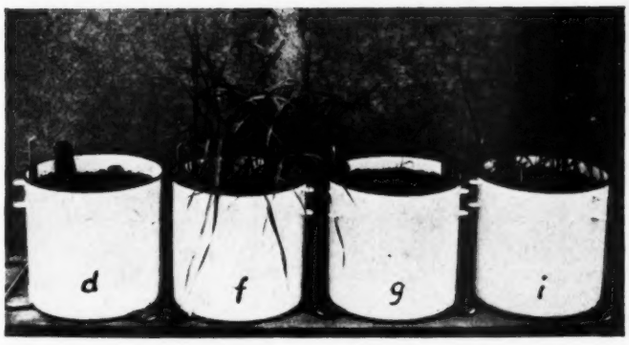
The degree of damage depends on several factors: (1) Size of crop plants – large well-developed plants are less

Test plot in bracken, photographed two years after treatment with sodium borate showing that borates in heavy doses act as a bracken control

Photo: J. D Forrest

* *Weed Control Handbook.* Blackwell Scientific Publications, Oxford. 12s. 6d.

liable to damage than small poorly developed plants, such as are found in undersown crops; (2) the chemical and rate of application - CIPC is more toxic than propham; (3) the amount of cover of the soil by the crop or by weeds – the damage was greater where this was low; (4) rate of evaporation at time of application – slow evaporation tends to increase damage (propham is more volatile than CIPC); (5) rainfall following spraying – heavy rain tends to increase damage.



Results after eight weeks of frost
Pot d: TCA applied prior to frost
Pot f: Untreated
Pot g: TCA applied immediately after frost
Pot i: TCA applied after four weeks of growth after frost

Photo: A. Bylterud

Chemical Treatment of Bracken in Scotland *by E. Conway (University of Glasgow) and J. D. Forrest (West of Scotland College of Agriculture)*

Of the recent new non-selective herbicides, only sodium borate at 4–8 lb. per 10 sq. yd. and sodium borate/chlorate and sodium borate + 2,4-D at 2–4 lb. on 10 sq. yd. have given real control of bracken 18 months after treatment. These non-selectives, due to their high rate of application and present high cost, would be impracticable to use for the control of bracken on a field scale. They would, however, be of use on forestry firebreaks or for 'mopping up' areas which are inaccessible to cutting or bruising machines.

Of the selective herbicides, ATA at 20 lb. per acre and 40 lb. per acre causes the next year's fronds to be later in emerging and invariably chlorotic. However, all other vegetation is severely affected and it would appear that ATA shows little promise for the control of bracken.

Both dalapon and amino-triazole are translocated in the bracken rhizome and show frondular effects and reduction in density in the year after treatment, though when rhizome apices are examined no formative effects are noticeable.

Dalapon at 20 lb. per acre and 40 lb. per acre also retards frond development and causes weak fronds to emerge with malformations on pinnae segments. In the trials carried out there was no lasting effect on the creeping soft grass.

The Effect of Dalapon on Bracken *by J. D. Fryer, R. J. Chancellor (A.R.C. Unit of Exp. Agr., Oxford) and S. A. Evans (N.A.A.S.)*

This report gives the details of experiments carried out to determine the potential value of dalapon, 2,2-dichloropropionic acid, to control bracken, *Pteridium aquilinum*. These were initiated as the result of a single experiment on bracken sprayed in 1956, which showed that dalapon was worth further testing. In general, the results were very variable; 20 lb. per acre dalapon gave between 0 and 90% reduction of frond density in the year after spraying. The reason for this variability is unknown.

Grazing of *Pteridium aquilinum* by Sheep in South Wales *by R. Garrett Jones (N.A.A.S.)*

Bracken has been locally heavily grazed to the point of near or complete destruction by sheep in several localities in Wales. The phenomenon is described from observations made over the past four years.

From the severity of the observed grazing and from the regrowth of the protected area, there is little doubt that the weakening and eventual death in patches of the bracken is attributable directly to this grazing. The effect of grazing, continued throughout the growing season for several years, must, of course, be expected to be more drastic than that of any cutting treatment on bracken as on more usually grazed species.

There has been no indication, according to the farmers concerned, that the sheep have suffered any ill effects from grazing the fern.

Toxicity of Dalapon and Amino-triazole to Some Common British Grasses *by J. D. Fryer and R. J. Chancellor (A.R.C. Unit of Exp. Agr., Oxford)*

This report gives the results of a series of exploratory experiments on the toxicity of dalapon, 2,2-dichloropropionic acid, and amino-triazole, 3-amino-1,2,4-triazole, to a number of common grasses growing under varied conditions. The chemicals were applied at doses in the range 1–20 lb. per acre in August and September 1957. Assessment of the results was made in several ways, but great importance was placed upon the minimum dose required to give complete kill and the maximum doses that allowed (1) vigorous regrowth and (2) flowering respectively, during the spring or summer of the year after spraying.

The results show that different grasses vary considerably in their reaction to these herbicides.

Control of *Agropyron repens* by TCA *by Arne Bylterud (Norwegian Plant Protection Institute, Vollebekk, Norway)*

Couch grass, *Agropyron repens*, is the most urgent weed problem in Norway. During recent years it has become more widespread where cereals are not grown in rotation with other crops.

A number of grass-killers have been tested at the Norwegian Plant Protection Institute, including TCA, dalapon, sodium chlorate, MH, ATA, chlorosol A, monuron, CIPC, propham and ammonium sulphamate. Of these, TCA has given the most promising results, but it does not solve the problem completely, as cereals cannot be grown after a TCA treatment. Cropping has to be limited to species with considerable TCA resistance. This is undoubtedly an advantage, as the farmers are forced to use crops other than barley, oats and wheat in rotation.

The recommendations for the use of TCA under Norwegian conditions differ from those of other countries.

It has been found that 20–25 kg. TCA per ha. sprayed as early as possible after snow melting in the spring gives satisfactory control of couch grass and allows satisfactory after-cultivation of the following crops: kale, swedes, turnips, cruciferous oil

crops, cabbage, beets, carrots and certain potato varieties.

Some Experiments on the Effect of Dalapon on *Agropyron repens*, *Agrostis gigantea* and *A. Stolonifera* by *J. D. Fryer and R. J. Chancellor* (*A.R.C. Unit of Exp. Agr., Oxford*)

This report describes the results of 10 experiments with dalapon, 2,2-dichloropropionic acid, on *Agropyron repens*, *Agrostis gigantea* and *A. stolonifera*, the three most important creeping perennial grass weeds of British agriculture. Applications were made at different times of the year with doses ranging from 5–40 lb. dalapon a.e. per acre.

Variable results were obtained. This is attributed to a dormancy-inducing mechanism of dalapon.

Forest Pests

It is reported from Prague that Dr. Jaroslav Weiser, a biologist, has developed an effective method of breeding *B. thuringiensis*. These are insect-killing bacteria used for the destruction of crop and forest pests. Preparations for industrial production are under way.

Another interesting development is the production of a special slide-rule for farmers – the 'Logarex' – for calculating the feed requirements of cattle, horses, sheep, pigs and poultry.

The Cactus

(*Continued from page* 189)

Commercial production and distribution

Gates estimates that only about 75 of the 2,000 known varieties can be grown profitably in large-scale commercial production. His sales annually exceed the million mark and he ships not only to most states, but also to many foreign countries, at prices ranging from 25 cents to $25 for a single plant.

They are packed in special cartons, the multi-spined varieties being carefully placed in layers of shredded paper. As the plants are capable of standing long waterless periods and take almost any abuse, they can be shipped in this manner to almost anywhere in the world and still arrive in good condition.

Coming Events

Agronomy – The First World Congress on Agronomic Research will be held in Rome from 7–9 May. Further information from the Organisers, International Confederation of Technical Agriculturists (C.I.T.A.), Beethovenstrasse 24, Zurich, Switzerland.

Plant Breeding. – A course on 'Plant Breeding and Crop Improvement' will be held in Cambridge from 21 June–4 July. It will be directed by Dr. G. D. H. Bell, Director of the Plant Breeding Institute, where most of the lectures and demonstrations will take place. The course is designed primarily for overseas graduates with experience of plant breeding. Applications should be addressed to: The Director, Courses Department, The British Council, 65 Davies Street, London, W.1.

Dairying. – 15th International Dairy Congress will be held in London from 29 June–4 July. Details from Mr. A. W. Marsden, Organising Secretary, 86 Brook Street, London, W.1.

Grassland. – The Summer Meeting of the British Grassland Society this year is to be held at Larne, Northern Ireland, from 30 June–3 July. Enquiries to J. Lowe, Esq., British Grassland Society Secretary and Treasurer, Agriculture Building, Elmwood Avenue, Belfast, Northern Ireland.

Seed Testing. – An International Convention on Seed Testing will be held in Oslo from 6–11 July. Particulars may be obtained from Seed Testing Association, Danish State Seed Testing Station, Thorvaldsensvej 57, Copenhagen, 5, Denmark.

Agricultural Economics Extension. – A course on 'Methods and programme planning in agriculture and home economics extension' has been arranged at Wageningen from 6–31 July. It is organised by the International Agricultural Centre at Wageningen with the support of the Netherlands Ministry of Agriculture, Fisheries and Food, FAO and OEEC. Further particulars from the Secretary, International Agricultural Centre, 1 General Foulkesweg, Wageningen, The Netherlands.

Botany. – The Ninth International Botanical Congress, organised by the International Union of Biological Sciences, will be held from 19–29 August in Montreal. Details from Dr. C. Frankton, Secretary-General, Ninth International Botanical Congress, Science Service Building, Carling Avenue, Ottawa, Canada.

Agricultural Exhibitions

New Zealand – This year the Waikato (Agricultural) Winter Show will be held from 26 May – 2 June at Hamilton, New Zealand. Further details from Waikato Winter Show Association, Box 616, Hamilton, New Zealand.

Spain – Madrid is to be the centre for an Agricultural Exhibition from 28 May–23 June this year. Enquiries to Fl. Comisario General de la Feria, Int. del. Campo Ministerio de Comercio, Castellano 14, Madrid, Spain.

Norway.– An Agricultural Jubilee Exhibition is to be held in Oslo from 11 June–5 July. The Exhibition aims at showing every aspect of Norwegian agriculture, as well as celebrating the 150th anniversary of the Norwegian Royal Society and the 100th anniversary of the Norwegian Agricultural College. Enquiries should be addressed to Norges Varemesse, Tollbudgt 2, Oslo, Norway.

Royal Show. – This is to be held from 7–10 July at Oxford. Particulars from the Royal Agricultural Society of England, 35 Belgrave Square, London, S.W.1.

Polish Tractors

The C-308 is a small horticultural tractor which can haul a trailer with up to a ton load, and can also be adapted for ploughing. It is a single-axle vehicle with an 8-h.p. engine and the space between the wheels is adjustable from 54 to 78 cm. Serial production began this year at the Ursus tractor works in Warsaw.

The prototype of the C-325, also built at these works, underwent tests in 1957. This is a two-axle tractor with a 25-h.p. engine and the distance between rear wheels is adjustable between 125 and 150 cm. (50–60 in.). Fuel consumption is 10 kg. per ha. of ploughing. Its weight is 1,360 kg. and it is suitable for work on both light and heavy soils.

New Publications

Conservation in Africa

The Conservation of Natural Resources. By R. C. Haw, B.A. (HONS.). Pp. 256. Illustrated. London: Faber and Faber. 1959. 30*s*.

This book has a slightly misleading title, as it deals specifically with soil and water conservation from the African angle. It should, nevertheless, prove of great value as a simply and clearly written manual for any school or group teaching soil conservation. The first chapter heading, ' Veldt and Vlei ', gives a useful and rapid survey of how conditions vary through Africa: ' veldt ' we know about, but ' vlei ' is a less generally known word outside Africa; its definition was eventually found on page 54 and it means a swamp that is not quite a swamp. This page 54 proved elusive because the printer's devil had taken a hand in the paging, 65 to 80 preceding 49 to 64 and then 33 to 48, so purchasers should examine their copies for kopjies!

The author gives a qualified approval to grassland burning, but stipulates a *hot* burn, but with rain both before and after the burning to be really effective; this seems to be staking too heavily on a stable and well-behaved climate. He complains much of bush invasion into grassland, but this is surely nature's own answer to grass fires. Generalisations are dangerous about the effect on run-off of clearing or not clearing bushes to encourage grass growth, and also of felling trees from top lands to raise the water-table. It is perhaps unfair to take statements out of their context, but the reviewer finds it difficult to believe that ' The falling water-table in Rhodesia is partly the result of bush encroachment. Stumping of top lands has resulted in raising the water-table over large areas '.

In his analysis of ' types of erosion ' the author starts with sheet-wash and gullying, then goes on to rill erosion and raindrop erosion. Surely there is confusion of thought here. The logical beginning is with the raindrop hitting the ground, after which the usual sequence is sheet-wash, then rilling, then gullying.

' Contour ridging ' is very sensibly used as a portmanteau word to include every type of bench terracing and narrow- and broad-based terraces, but Table 5 on page 134, for vertical intervals and horizontal espacements for various ground slopes, headed ' Contour Ridges ', should specify bench terracing and a narrower horizontal espacement – for instance, a 70- to 80-ft. width and a vertical bank of 7 to 8 ft. drop is far too wide to be economic for a slope of 1 in 10; two bench terraces each half the width and with half the vertical drop would be cheaper and fully ploughable by bullock-drawn ploughs.

Bookshop Service

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Technical Books,
308 Euston Road,
London, N.W.1.
Telephone: Euston 5911.

Other miscellaneous publications reviewed should be obtained direct from the addresses given.

The two Tables 6 and 7, giving the dimensions for grassed waterways, are useful for the smaller flows, but would be risky to use for anything over 200 cusecs, even for the gentler gradients, unless the grass surface in the waterway were of an unusually tenacious and perennial type. Deep subsoiling is recommended for sheet-eroded land, but experience in alluvial soils is that the fractures made by the machine in the subsoil are fairly quickly sealed by the top soil which is washed down into them, so the subsoiling has to be repeated at intervals; the effect is by no means permanent. In view of this recommendation of mechanised practice, it is surprising to find the use of earth-moving machinery criticised as more costly than the bullock-drawn scoop for the building of dams; the experience usually is that mechanical means, given the correct choice of equipment for the job, are cheaper as well as quicker than working with animals.

R. MACLAGAN GORRIE

Pests of Cotton

The Insect Pests of Cotton in Tropical Africa. By E. O. Pearson, assisted by R. C. Maxwell Darling, O.B.E. Pp. 355. Eight plates in colour. London: Empire Cotton Growing Corporation and Commonwealth Institute of Entomology. 1958. 40*s*.

Cotton has been grown from ancient times in some parts of Africa. The original introductions from Asia have been replaced in comparatively recent years by varieties from the New World and today cotton is very widely cultivated in Africa.

The published literature on cotton pests in Africa is vast and scattered. In this book, concerned with the insects particularly associated with cotton south of the Sahara, the author has embodied, comprehensively yet concisely, much published information, as well as the results of his own exceptional experience of the pests of cotton in Africa.

There are two introductory sections to the book. The first deals briefly with the cotton plant and its introduction into and cultivation in Africa. The second section gives a general account of cotton pests, the systematic groups to which they belong, their geographical distribution, their origin and brief discussions of what insects attack the different parts of the plant under African conditions and the effects of insect attack on yield. Notes are also given on the different cotton-growing areas in tropical and subtropical Africa and their most important pests, and there is a very useful key to the principal pests and diseases from which cotton suffers in Africa.

The body of the book gives a detailed account of each of the principal pests or groups of pests, facilitating their ready recognition in the field. A discussion of the use of insecticides on cotton in Africa has been contributed by R. C. Maxwell Darling as an appendix.

Apart from the factual information given on cotton pests, the book discloses the development of applied entomology in Africa during the past 20 years, the emphasis on the ecological approach and the importance of population studies being quite modern. The results of more than 30 years' research in Africa is embodied in this volume,

which should be invaluable both to cotton growers who are not entomologists and also to specialists working on African cotton pest problems.

E. F. S. SHEPHERD

Barley Varieties

By G. Aufhammer, P. Bergal and F. R. Horne. Pp. 159. Illustrated. Second edition. Netherlands: Elsevier Publishing Co., Spuistraat 110-112, Amsterdam. In Eng., Fr. and Ger. Price not stated.

Barley is not only one of the most ancient, but it is also one of the most widely distributed of the cultivated cereals. It is grown at high altitudes as well as below the sea level – in the Arctic circle as well as in the sub-tropics and tropics. The interchange of suitable varieties is, however, confined to more geographically restricted areas. Europe, and especially its northern and north-central part, including the U.K., is one such area where only a relatively small number of varieties of rather similar type can be grown.

The publication of the second edition of this book, which has been composed on behalf of the Barley Committee of the European Brewery Convention, is, indeed, an important event for farmers, plant breeders, seed producers, brewers and the seed trade.

The book contains a full description of each of some 40 varieties grown in Europe. It indicates the origin and name of the breeder and then proceeds to the botanical description of ear and grain. A clear and simple description of the vegetative and agronomic character of the variety and grain quality follows. This last is of special importance for the brewer. Each table contains a photograph of the ear of the respective variety and two shots, one of the front and one of the reverse side, of the grain. The excellence of these pictures is a great help in identification and effectively completes the extensive descriptions of the varieties.

Though all varieties mentioned have been grown in Cambridge at the National Institute for Agricultural Botany in order to study their botanical characteristics, the field behaviour to which the vegetative and agronomic characters refer is described in accordance with findings in their country of origin. This is of importance, because foreign climates and environment are apt to change some of the characteristics of the varieties, as, for instance, length of straw, maturity etc. Grain quality is compared in all instances with that of the old and well-known Kenia barley. Some very interesting pedigrees are included. These give a good insight into the build-up of Danish, German, French, Swedish, Dutch, U.K. and Irish varieties.

This excellent and very thorough book of reference, with its neat and clear presentation of all relevant data and excellent photographs, can be highly recommended.

C. DE FELLNER

Machines on the Farm

By H. J. Hines. Pp. 224. Illustrated. London: Odhams Press Ltd. 1959. 25*s*.

Farm machinery is produced in such bewildering variety that the farmer may well be perplexed in his choice of machines best suited to his particular farming conditions. While the farmer must use his judgment in this matter, he will find guidance from Mr. H. J. Hines's latest book, ' Machines on the Farm, in which the operation and maintenance of modern farm implements are described.

Successful farming entails more than the choice of the right machine for the right job; it demands training a team of men who will not merely operate the machines efficiently, but will observe a routine for their care and maintenance. How inefficient farm organisation can be in this respect is evidenced by the condition of farm machinery to be seen awaiting repair at garages and blacksmiths' shops in Britain, and this is even more marked in countries overseas, where whole armies of tractors have often been laid up because of trivial faults due to neglect of routine cleaning and maintenance. Mr. Hines provides a valuable guide to maintenance work essential for each machine which, if followed, would obviate much of the expense and disorganisation on the farm.

The book consists of 15 chapters, each dealing with a particular set of arable farm operations in temperate climate countries, *e.g.* ploughing, planting, fertilising, spraying and dusting, harvesting, grain drying and transport, and covering all the usual farming operations throughout the year. Curiously, ' Preparing Land for Cultivation ' is the subject of the final chapter rather than, as one would expect, the first chapter.

The efficiency of farm machinery depends largely on a thorough knowledge of the work for which each machine is designed and on correctly setting the machine to perform its task. If due regard be paid to these matters, wear is reduced to a minimum and breakdowns reduced in number and seriousness. The author shows knowledge of the construction and working of the machines and his hints on their use are therefore essentially of a practical nature.

Time study

Where, however, the book differs from the numerous publications on farm machinery is the emphasis he places on time and method study in farming. While he admits that detailed work study may not be practicable on farms, he considers that critical examination of the work to be done, its timing and the machines and men involved will repay the farmer. He appears diffident in forcing this view too far because cultivation problems cannot be foretold owing to vagaries of the weather. Improvisation is therefore inseparable with farming; nevertheless, the timing of many farm operations may be worked out beforehand and will undoubtedly result in labour economy and greater efficiency.

Mr. Hines's book may be confidently recommended to agricultural administrators, farmers and students. In addition to being a thoughtful and practical treatise, it is concisely presented, excellently produced and provided with numerous illustrations which really do assist the text.

D. H. GRIST

Forestry Commission

Britain's New Forests describes the work of the Forestry Commission in promoting the growth of timber. It is planned to double the present extent of effective forest by replanting felled woodland and afforesting some of the moors and hillsides of least value for grazing livestock.

Training as a Forester, issued as a guide to young men interested in a forestry career, describes the scope of such work, the training provided and the type of appointments available.

Pamphlets obtainable from the Secretary, Forestry Commission, 25 Savile Row, London, W.1.

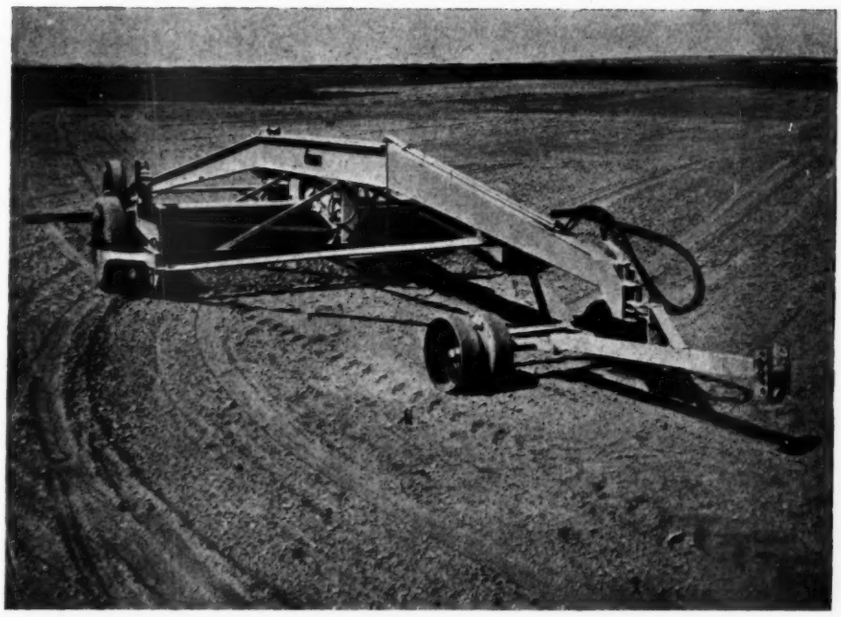
Machinery and Equipment

Land Smoothing

In spite of the tremendous strides which farm mechanisation has undoubtedly taken in the last decade, little attention has been paid to preparing the land's surface, so that modern farm machinery can be operated at maximum efficiency. Land smoothing will result in less operator fatigue, substantially lowered maintenance and repair charges, fewer delays due to breakdowns, more uniform seeding at a predetermined depth, more exact down-the-row thinning on a broader swathe, and finally much greater efficiency in the operation of wider combine machines, wider hay cutters, longer boom sprayers, and wider rakes and planters.

Land smoothing and levelling is also necessary for other reasons – to secure effective irrigation using less water by the elimination of high and low spots and thus obtaining accurate control of the water distribution in irrigation. It is also desirable for rain-watered crops, otherwise plants will be drowned or retarded in waterlogged areas or will be under-developed through lack of water in the higher and drier parts of the field.

With an *Eversman* leveller and a standard tractor it is an easy matter to smooth and level large areas of land, to cut off the high spots, eliminate potholes and so obtain the proper grade. The machine will produce the ideal seedbed for wheat, barley, oats, rice, tobacco, groundnuts, pineapples, maize etc.; it will make planting more uniform; cultivating, spraying, fertilising and weeding easier; and, where mechanical harvesting is possible, will make it faster with fewer delays due to breakdowns.

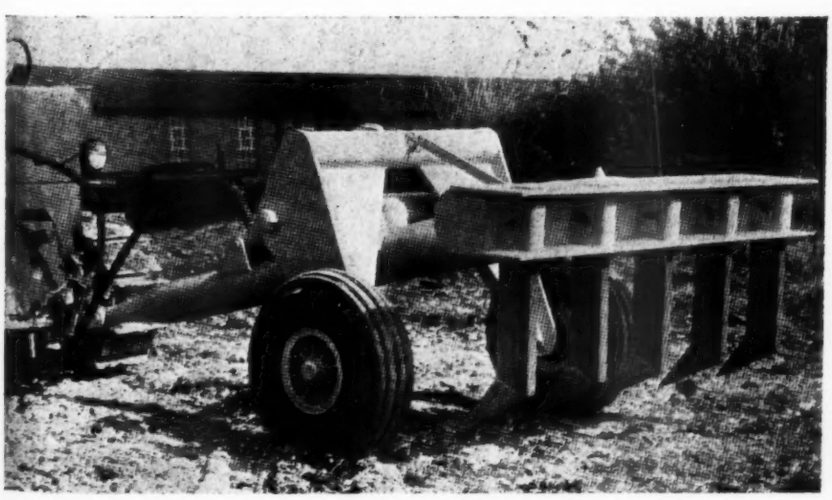


The Eversman hydraulic scraper and land smoother for use with a standard large-wheel tractor or a small crawler tractor

Scrub Clearance and Subsoiling

The *Conder* hydraulic ripper is designed to operate behind tractors fitted with hydraulic equipment, to which it can be coupled in a few moments. There are two models – the ½-ton ripper is for tractors of 20–25 h.p. and the ¾-ton machine is for tractors of 35–40 h.p.

The machine is intended for deep subsoil penetration; the tines of the smaller model will penetrate to a maximum depth of 18 in., and the larger to 22 in. The implement is a really robust job, which would appear to be suitable for scrub clearance and the reclamation of land covered in secondary jungle.



The Conder hydraulic ripper is specially designed for deep subsoil cultivation

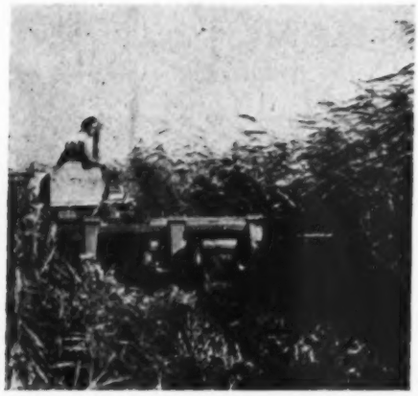
Swamp Reed Control

Since the first plan for enclosing and draining the Zuiderzee was made some 70 years ago, about 300,000 acres have been reclaimed.

Work is now in progress on the 150,000 acres of the Markerwaard polder.* After the enclosing dykes have been completed, the polder is pumped dry and reeds are sown by aeroplane. These extract water from the land and at the same time help to suppress the swamp weeds, which are difficult to eradicate.

Until recently the reeds and the weeds were removed by cutting with a mower or swather, windrowed in 30-ft. strips, allowed to dry and, in the early spring, burnt. This was a slow and

* Polder : Area of low-lying land reclaimed from the sea.



A Lundell shredder cutting and shredding reeds up to 8 ft. in height

expensive process and was not very effective, because the material did not burn well; disking was also necessary and it was often months before ploughing could begin.

Now *Lundell* shredders, an adaptation of the ' Super 60 ' offset forage harvester, are being used. The reeds grow up to 8 ft. high and yield up to 25 tons per acre, but the shredders are working at the rate of 2 acres per hour and covering 7 km. They are driven by *Caterpillar* D4s and, on exceptionally wet ground, by *Swedish BMs*.

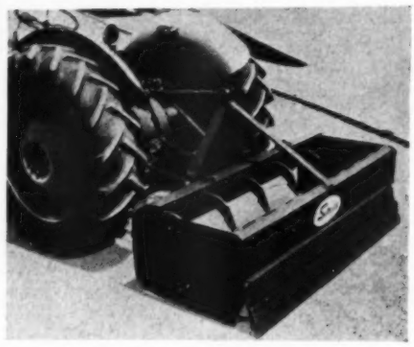
Soil Scraping and Levelling

The *Servis Equipment Co.*, of U.S.A., has introduced a new and improved type of soil scraper for high-speed spreading, levelling and scarifying and for operation in close quarters. There is a 66-in. model and a 72-in. model, the latter being designed for the larger tractors.

The design incorporates an easier latching system for the scarifier teeth and a different curve in the mould-board section ensures a full load of dirt. A full-length bumper on the rear blade will prevent it bending under severe and rough service.

Fast Earth-moving

Vickers 'Onions' open-bowl scrapers have been designed to match the increased drawbar pulls of present-day tractors and there is a model for every size of the principal makes of crawler



The new Servis soil scraper

tractors. They are of rugged construction, with a low deadweight and the high apron lift allows the quick discharge of difficult materials. The heavy balloon tyres which are fitted fore and aft give maximum stability and minimum rolling resistance.

Variable Feed Device

The Lea-Bar ' Vibra ' feeder offered by *W. S. Barron & Son Ltd.* is electrically actuated and provides a method of feeding materials of a dry nature at a steady rate at different speeds into grinders, pulverisers and feed mixers. An electro-magnet with variable amplitude control determines the intensity of the vibration, producing long strokes for light material and short strokes for dense, granular material.

When actuated the magnet pulls the tray sharply back and then releases it, and it is returned to its original position at a slightly slower rate by springs when the magnet is dead; this cycle is repeated at high speed. An infinite variation in the rate of flow from zero to many tons can be effected by a simple adjustment.

Land Levelling

A precision land-levelling tool, produced by the *Marvin Landplane Co.*, of U.S.A., consists of a cantilevered beam mounted on four wheels and carrying a mid - mounted scraper. There are several models, ranging from

The Lea-Bar feeder showing the observation window and the box housing the electro-vibrator

20 ft. to 80 ft., and it is possible to switch from one model to another by the addition or removal of a 10-ft. extension unit. This extension is stated to increase the efficiency of the implement from 25 to 50%, depending on the overall length. There are four scraper widths: 8 ft., 9 ft., 10 ft. and 12 ft. The crawler tractors used to draw the leveller should exert from 35 to 65 h.p. at the drawbar.

The Vickers Onions ' 6-8 ' scraper is used with 55- to 75-h.p. crawler tractors

A Burning Question

It is well known that the ' Sheen ' flame gun has many useful applications in the garden, such as the burning of grass and weeds, the clearing of paths and drives, the sterilisation of seedbeds and the conditioning of soil, but it has also a wide variety of other uses on the farm, in the market garden and in tropical plantations. The same machine could, of course be used for destroying bracken, secondary jungle, weedy undergrowths, estate litter, clearing drains and ditches of choking weeds, making firebreaks and keeping jungle tracks clear. In this type of

work a further advantage is that mosquitoes, fly grubs and plant pests, snakes, scorpions and centipedes and superficial termite galleries are destroyed at the same time.

This flame gun, which is manufactured by *Hugh Pritchard & Co. Ltd.*, is also recommended for sterilising and disinfecting farm utensils, swill tubs, pigsties, hen runs, brood houses, dairies, stockyards, dog kennels, turkey runs, stables and also house drains, which are so often coated in objectionable slimes and accumulations of kitchen wastes, wherein flies may breed. Regular attention to these matters can be very effective in preventing disease, particularly in tropical countries.

The ' Sheen ' flame-gun can be used for burning grass and weeds as well as for sterilising seedbeds and conditioning the soil

In colder countries, particularly in the depth of winter, a flame gun provides a handy source of intense heat in portable form. Frozen pipes can be dealt with and machinery and equipment that have become frozen into the ground can be lifted. It could also be used for lighting furnaces, boiling water and other liquids *in situ*. Tarmac roads and asphalt paths can be patched and repaired and, of course, any areas of concrete, gravel, laterite, asphalt, shale or crazy paving can be kept cleared of weeds.

Mechanised Cultivation

With the versatile ' Monrotiller ' and its range of easily fitted attachments it is possible to carry out a wide range of operations; it can be used for rotary cultivation, for hoeing or furrowing, for cutting or mowing grassy swards, for crop spraying and hedge trimming, for transporting solids and liquids in trucks and tanks, for pumping water, for sawing timber or for driving machinery.

With a special appeal for the small farmer and market gardener, this *Geo. Monro* product will also have obvious uses in tropical agriculture for keeping cover crops under effective control, for incorporating organic matter, manures and fertilisers into the soil, and for keeping the circles round young coconut palms, tea bushes and young rubber trees free of competing weeds.

Aerial Dusting, Spraying and Seeding

The ' Swathmaster ' is a remarkable all-purpose dispensing unit, produced by *Transland Aircraft*, for attachment to the Starmane PT-17 aeroplane;

The versatile ' Monrotiller ' has a powerful and reliable 4-stroke engine

tests are also being made to determine its suitability for use on other agricultural aircraft.

It is a device for dusting, spraying, seeding and the application of fertilisers, and it can be quickly switched from one type of work to another simply by resetting the micrometer control. Thus only one aeroplane is needed to carry out a variety of jobs without any time being lost in changing the equipment or in modifying it from dust to spray, and *vice versa*. Because of its very simple design, the absence of valves and nozzles and the few moving parts, it requires very little

A ' Swathmaster ' equipped aeroplane spraying cotton against mite and lygus in California

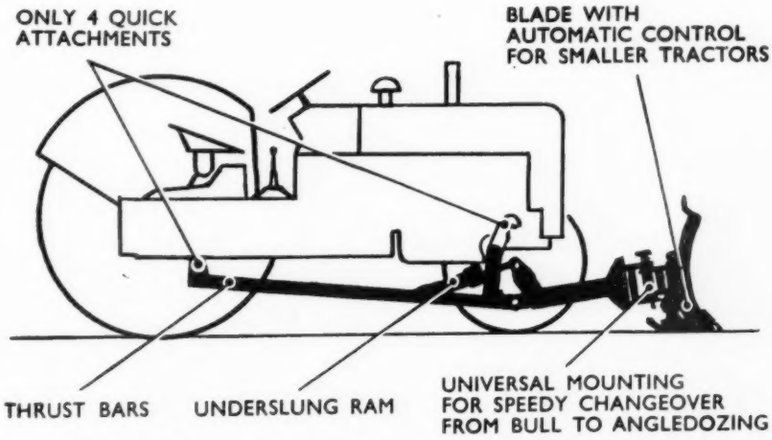
servicing, cleaning and maintenance.

The machine consists essentially of a stainless steel hopper fitted with a dust lid and a liquid filler cap, an agitating box fitted with paddles actuated by a wind-driven propeller, a forced-air intake to provide the necessary dispersing force, and a liquid flow regulator which automatically increases the gate opening so as to compensate for the loss of head in the hopper during a run. The gate control is readily adjustable on the ground, or in flight, to give any desired rate of dust or spray application by means of a micrometer screw. Perforations are provided through which the materials are evenly distributed into the air stream.

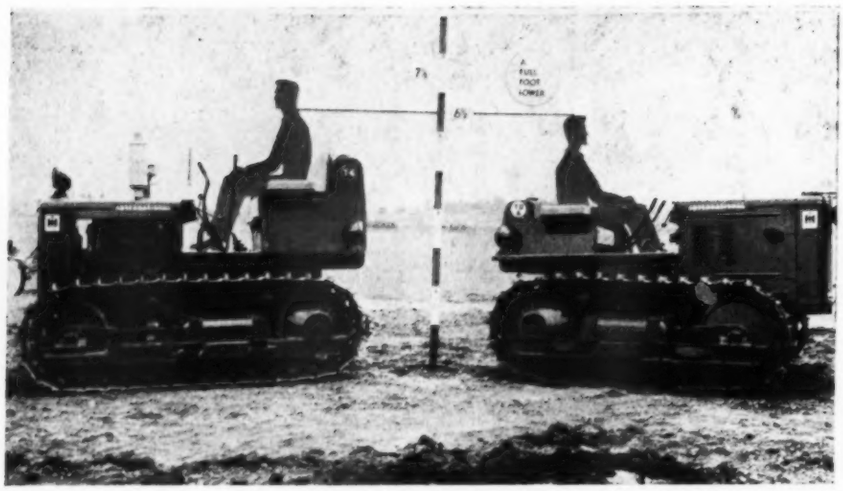
It can be used to dispense high- or low-density dry dusts; granular materials, seed and pellets up to $\frac{1}{2}$ in. dia.; and solutions, emulsions and solids in suspension. It is also claimed that it has successfully dispensed some of the new ' invert ' or jelly emulsions (see WORLD CROPS, 1959, **11**, 45).

Underslung Bulldozer

An interesting innovation in earth-moving equipment is the underslung


ONLY 4 QUICK ATTACHMENTS
BLADE WITH AUTOMATIC CONTROL FOR SMALLER TRACTORS
THRUST BARS
UNDERSLUNG RAM
UNIVERSAL MOUNTING FOR SPEEDY CHANGEOVER FROM BULL TO ANGLEDOZING

The new ' Sapper Powerdozer ' is mounted beneath the tractor body



The new International T-6 tractor with its lower seating position gives an additional clearance of 1 ft., compared with the standard model

bulldozer made by *Bomford & Evershed Ltd.* for fitting to wheeled tractors with hydraulic power. This new bull-angledozing blade is known as the ' Sapper Powerdozer ' and is at present available for the *Fordson* ' Major ' and ' Dexta ', the *David Brown* 900 and ' Livedrive ', the *Nuffield* 3 and 4, and the *International Harvester* B-250 tractors.

The attachment points are only four in number; the blade can be quickly attached and it is then operated hydraulically by a small ram mounted beneath the tractor body. This sturdy unit is very manoeuvrable and is suitable for light earth-moving operations on the plantation or farm.

Mowing of Orchards

Farmers, smallholders and research workers who have to mow orchards and grass paddocks and other areas having rough and uneven surfaces will be interested in the new 24-in. side-wheel ' Atco ' motor mower which has just been introduced by *Charles H. Pugh* to meet the needs of all who require a ' rough-cut ' machine capable of working long hours under arduous conditions. It is claimed that it will also deal effectively with crops of long grass well outside the range of most other machines.

It is fitted with the powerful Mk. 12, 4-stroke *Villiers* engine, which is air-cooled, both by fan and cowl. The heavy-duty twin-disk clutch transmits the engine power to the extra heavy cutting cylinder and wheels. The drive is enclosed by chains to the cutting cylinder and thence by gears to the rubber-tyred road wheels. The height of the cut can be varied from $\frac{3}{8}$ in. to 2 in. by a simple adjustment.

Road Grading

A 6-ft. wide grader blade can quickly be attached to the hydraulic lift of a Jeep. This *Willys-Overland* combination can then be used for regrading estate roads – for filling in the holes made by heavy traffic before the heavy rains come and for cleaning up the verges, and generally keeping such roads in first-class condition. Another application is the preparation of contour roads and terraces and the levelling of seedbeds on pineapple plantations. The heavy steel blade can be angled in order to produce a camber or to build reverse-slope contour terraces. It is rigidly supported by stabiliser bars, which ensure precision operation.

Low-clearance Tractors

To meet the special requirements of tropical plantations, fruit growers, foresters and colonisation officers, *International Harvester Export Co.* has now introduced a low-profile crawler tractor with seating a full foot lower than on the standard model and with operating controls specially modified so as to be within easy reach of the low-position seat.

There are two models – the T-6 petrol and the TD-6 diesel – and the special features are a low-profile 20-gal. fuel tank, a deck-mounted low-seat assembly, centre-mounted gear lever with other controls lowered to match this seat position, side-mounted batteries, side-outlet exhaust, protected air intake and robust head-lamps with guards, mounted low in front of the radiator to give a clean hood-line.

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Eden Street, London, N.W.1,
England

A Willys ' Jeep ' combination being used for cleaning up and re-cambering an estate road

Agricultural Chemicals

An unkempt gravel path in early summer. Traditional method of chemical weed control is not possible because of danger to nearby fruit trees

Plant Destruction

Apart from the fact that weed-infested areas are unsightly and can create a fire hazard to wooden buildings, they can also be a source of danger to crops growing outdoors and under glass. Weeds are often allowed to flourish because of the labour involved in their physical eradication.

Fisons Pest Control Ltd. now offer ' Weedex ', a persistent and effective weedkiller, based on simazine – a total weedkiller discovered by J. R. Geigy, of Switzerland – which belongs to a new group of herbicides, the triazines, and it is described chemically as 2 - chloro - 4,6 - bis - ethylamino - s - triazine. This is absorbed by the roots of plants and only slightly, if at all, by the foliage. It operates by causing a breakdown of the metabolic processes of the plant.

It is effective against a wide range of plants. It not only kills shallow-rooting weeds, but also perennials and deep-rooted weeds, but these take a little longer to succumb. This is because of its low solubility in water, which is of the order of five parts per million, so that when it is applied to the soil it remains in the surface layers and does not wash down even with heavy rainfall. This means that shrubs and trees with roots passing beneath the treated area are unaffected, and so it is safe to use it fairly close to fruit trees and bushes.

The insoluble nature of the material and its slow rate of breakdown is also the reason why it is so persistent and gives extended protection against fresh invasions of weeds. It is claimed that it will prevent weed seeds from germinating for a whole year. Its low solubility also means that the lateral spread of the material cannot take place, except under very extreme conditions, when there is surface erosion of the soil due to very heavy rain. This adds up to the conclusion that it can safely be applied to within a few inches of grass verges, flower beds, shrubs and deep-rooting shrubs and trees.

Simazine is of extremely low toxicity to humans and animals and is completely safe for handling. It is also non-inflammable, and non-corrosive to spraying equipment and watering cans.

The same path photographed a year later, after one application of ' Weedex ' which eradicated the weeds and left the fruit trees unharmed

Slugs and Snails

These two pests cause serious destruction on farms, market gardens, nurseries and allotments, since they attack almost every crop, doing particular damage to young seedlings (see Min. of Agric. Advisory Leaflet No. 115 – ' Slugs and Snails ').

The most deadly chemical known for their destruction is metaldehyde –popularly known as meta – which is best used in the form of a bait. *Standardised Disinfectants Co. Ltd.* have now formulated an attractive bait, containing metaldehyde, known as ' Brunobait '. This is offered in the form of dry pellets of uniform size, which are not blown away by wind or carried away by normal rains, or as a result of watering the plants. They are suitable either for broadcasting or for spot applications.

In tropical countries the giant snail, *Achatina fulica*, is a most ubiquitous and destructive pest, which can be found in thousands in the market gardens surrounding the limestone hills, and they are carried on agricultural produce to the town and village markets and so spread far and wide throughout the country. Under such conditions gardening becomes impossible without the regular and systematic collection of the snails and the use of meta baits. ' Brunobait ' would appear to provide the answer to the gardener's prayer.

Both slugs and snails feed mainly at night and are most active on still nights and when the soil is wet and the atmosphere is humid; during the day they shelter in cool, moist, dark places. The best results will therefore be achieved by putting down the pellets when the pests are most active on the surface of the soil on a warm, damp night and not in dry, frosty weather. The bait can also be placed among the daytime hideouts under tiles and similar cover.

It is good practice to clear ground of slugs before it is planted up and to prevent re-invasion from outside by means of a protecting ring of pellets 2 yd. in width. The normal rate of application is 25–28 lb. per acre.

More About Nematodes

Eelworms of minute size, swarming unseen and almost invisible in the soil, can do immense damage to the roots of established economic crops, such as bananas, cotton, tea, citrus, vines, strawberries, brassicas, sugar-beet and fruit trees.

' Nemagon ' is a new soil fumigant which represents an important advance in the chemical control of plant nematodes. Not only is this product highly effective at comparatively low dosage rates, but it also possesses the outstanding property that it can be applied around the root systems of a considerable number of established plants without harming them. This property now opens up the possibility of applying curative treatments to growing perennials suffering from

nematode attacks without having to resort to replanting.

This new nematocidal product is a formulation containing not less than 97% of the compound DBCP, 1,2-dibromo-3-chloropropane, not more than 2% nematocidally-active brominated or chlorinated C_3 hydrocarbons, and not more than 1% of inert compounds. It may be applied by injection of the liquid material into the soil or by soaking the affected area with a water emulsion of the fumigant, or as a granular formulation which may be broadcast over the surface of the soil or applied freshly mixed with fertiliser with an adequate coverage of soil.

Field tests, carried out by the *Shell Co.*, have shown that crops vary widely in their sensitivity to this product. Whilst a majority will tolerate the fumigant, there are a number which are extremely sensitive even to low concentrations. In such cases the slow rate at which it is dissipated from the soil makes it impracticable in many cases to employ a waiting period between fumigation and planting.

Tobacco seedlings are very seriously injured even by traces of this fumigant and have shown phytotoxic symptoms even when grown on land fumigated six months prior to planting. Against the potato root eelworm, *Heterodera rostochiensis*, too, it has not proved entirely satisfactory for the same reasons.

The experimental work already done has shown that nine species of nematodes can be controlled by 'Nemagon', that the nine economic crops listed above and nine other crops raised from seed are tolerant to this new fumigant. Work is still in progress and experimental studies have been initiated on pineapples, coffee, cocoa, peppers and papayas. The side-dressing of annual crops does not appear to be promising from the results obtained to date and for these pre-plant treatments appear to be necessary.

Choice of Weedkillers

In recent years the choice of weedkillers for normal farm use has widened rapidly; users are often bewildered by the large number of chemicals available and the many different brand names under which they are sold. In the interests of simplicity, the *Bayer* range has been kept to the three basic weed sprays of modern farming. These are 'Akrodrin' (MCPA) for general weed control in cereals and grassland, 'Buterex' (MCPB) for weed control where clover safety is of first importance and for weeds in peas, and 'Weedol' (CMPP) for the safe control of cleavers, chickweed and many other weeds in cereals. Applied at low volume they are safe to operators, livestock and game when used as directed.

'Akrodrin' is a special formulation of the active potassium salt of MCPA which contains an ingredient to make it suitable for use in hard-water areas. It generally gives an effective kill at the lowest cost, but where cleavers and chickweed are present 'Weedol' should be used. If spraying is required at a particularly early stage, 'Buterex' may be used as an alternative.

Whichever product is used, the best results will be obtained if spraying takes place in fine weather when growing conditions are good; the weeds are then most susceptible and the crop, after their removal, can grow away more strongly.

It is stated to be safe to spray wheat, barley and winter oats when the crop has developed five leaves. In the case of 'Weedol', winter-sown cereals may be treated in the spring from the time when they are well tillered and spring cereals from the four-leaf stage, while 'Buterex' may be used from the three-leaf stage. Most varieties of spring oats can be sprayed with 'Akodrin' and 'Buterex' after the appearance of the first leaf.

When annual weeds predominate, the best results will be obtained by spraying as soon as the crop has reached the safe stage, so that the crop will benefit fully from the removal of weed competition. If, however, perennial weeds are the chief problem, spraying with 'Akodrin' should be delayed as long as possible, while 'Buterex' should be sprayed at the time recommended for the weed.

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England

For Wireworm

'Alderstan EC-30' is an emulsifiable concentrate containing 3 lb. per gal. or 30% wt./vol. of aldrin. It is a free-flowing liquid formulation which, when added to water, gives a stable emulsion without any further mixing being necessary. The manufacturers, *The Standardised Disinfectants Co. Ltd.*, state that it gives off an insecticidal vapour which is particularly effective for the control of wireworms.

The insecticide is diluted in water, sprayed over the open ridges or furrows or directly on to the seedbed, after which the ground is cultivated before planting to avoid loss of insecticide by evaporation. The rate of application for wireworms is six to eight pints of the formulation in ten or more gallons of water; six pints for light, friable soils or moderate wireworm infestation and eight pints with heavy soils or if the infestation is severe.

It will also control chafer grubs and mole crickets at this dilution. A lower dilution is adequate for leatherjackets and cutworms and for the control of cabbage root fly. It may also be used to control ants by spraying in and around their nests and as a bait for leatherjackets or cutworms by mixing ½ pint with 25 lb. of bran and broadcasting the mixture at 25–40 lb. per acre.

Fluoracetamide

From a previous editorial on 'Virus Yellows' (WORLD CROPS, 1959, 11, 78) it was not clear that fluoracetamide, although not as dangerous as sodium fluoracetate, and although it is not an organo-phosphorous compound, is, in fact, a poisonous substance.

Fluoracetamide is included in the Agriculture (Poisonous Substances) Regulations as a Part 2 substance and when it is used by agricultural workers the same precautions are required as, for example, for parathion and schradan (*vide* Leaflet APS/1 (revised May 1958), Min. of Agriculture, Fisheries and Food).

Soil Reactions

In the April issue, under this heading, it was stated that a recent Canadian study indicated that molybdenum, added in the form of sodium molybdate, increases yields of red clover considerably. This information was received from *American Metal Climax Inc.*

World Crop Reports

INTERNATIONAL REPORTS

Barley and Oats

World production of barley and oats in 1958 is estimated at 146.2 million short tons, or 5% larger than in 1957.

In addition to exceeding the 1957 crop, the total out-turn of the two grains was about 12% above the 1950–54 average. It was, however, slightly below the record crop of 149.4 million short tons in 1956, mainly because of a substantially smaller barley crop.

Barley production in 1958 is estimated at 3,275 million bushels, 115 million bushels more than last year, but 115 million less than the record production of 1956. Increases over the 1957 crop were greatest in *North America*, *Africa*, the *U.S.S.R.* and *Oceania*. Those increases were partly offset by smaller harvests in *Asia* and *Europe*.

Production of oats is placed at 4,225 million bushels. This is 235 million more than last year and 65 million more than the 1950–54 average. The bulk of the increase over 1957 was in North America and the U.S.S.R., though a substantial increase is also reported for Australia.

North America produces about a third of the world's barley and oats, combined. Large crops this season, especially in the U.S.A., together with record or near-record carry-over stocks, bring supplies for the current season to a new record level.

Oats production totals 1,829 million bushels, 144 million more than in 1957. The bulk of the increase is in the U.S.A., where the production of 1,422 million bushels is well above average. Canada's production, though above the small 1957 harvest, is still below average. Total barley production of 725 million bushels reaches the high level because of a record U.S. crop and Canada's above-average production.

Castor beans

World production of castor beans in 1958 is estimated at almost 528,000 short tons, down 6% from the relatively large out-turn of 1957, but slightly larger than the 1950–54 average. The outlook for 1959 appears more favourable, with indications of possible increases in India and Brazil, the major producing countries, and continued expansion of some smaller producing countries.

The estimated 31,000-ton decline in 1958 from the previous year is due chiefly to smaller, drought-reduced crops in Brazil and India. The smaller out-turn in these two countries was only partially offset by increases in the U.S.A., Ecuador, Mexico and other relatively small producers. Brazil and India normally account for 60 to 65% of world output and about two-thirds of world trade in castor beans and oil.

With the expansion in the U.S.A. and Mexico, North American production more than doubled that of the previous year. On the basis of trade estimates, the 1958 castor bean crop in the *U.S.A.* probably totalled around 30,000 tons, three times the volume in 1957. A crop of this size, if all crushed, should yield around 13,500 tons of oil or about one-fifth of domestic requirements. Practically all the beans are grown under irrigation, with California accounting for nearly two-thirds of the U.S. output. The average yield per acre in 1958 is placed at 2,075 lb., compared with 1,680 a year earlier.

Mexico's 1958 crop is substantially larger than last year's, apparently because acreage increased by a quarter. Forecasts for 1959 production are for increases in castor beans as well as all other oilseed crops.

South American castor bean production dropped an estimated 9% from last year as a result of the sharp decline in Brazil. Production in Brazil was set back by drought in the north-eastern states. Unofficial estimates place the 1958 crop at about 190,000 tons, compared with the official estimate for 1957 of 213,000 tons. (Trade sources estimate 1957 production at about 254,000 tons.) Indications in late October were that production in 1959 would increase significantly. Unofficially the crop was forecast at around 250,000 tons. Castor production in Ecuador, the second largest South American producer, increased by one-quarter over 1957.

The relatively small output in *Europe*, where Rumania is the major producer, probably did not change greatly in 1958. Production is now only a fraction of the pre-war output.

Countries in *Africa* produce relatively few castor beans.

With the sharp drop in Indian production, total output in *Asia* is down an estimated 14% in 1958. India's crop is reported at 108,640 tons, one-fifth less than the stable harvests of the three previous years. Adverse weather accounted for the decreased acreage and production. The 1959 crop, which will be harvested early next year, is expected to approximate the annual level of 1955–57.

In Thailand production of castor beans, as well as other oilseed crops, has increased in recent years. With prospects for continued increases, castor production in 1958 probably reached the 36,000-ton output of 1957. Production in Iraq has averaged about 13,000 tons in recent years.

REGIONAL REPORTS

Nigeria

Nigeria's 1958–59 *cotton* crop, now being harvested, is estimated at 165,000 bales (each 500 lb. gross), down 20% from last year's record crop of 205,000 bales. The decline is attributed mainly to a lack of rain in parts of the northern region, where most of Nigeria's cotton is grown. Cotton acreage for 1958–59 is estimated at 800,000 acres, compared with 850,000 acres in 1957–58.

Sudan

The 1958–59 *cotton* crop in Sudan is now estimated at 616,000 bales (500 lb. gross). This is a substantial increase from last year's poor crop of 225,000 bales and only slightly below the record 617,000 bales produced in 1956–57. With the large carry-over of 309,000 bales on 1 August, 1958, the total supply in Sudan for 1958–59 is expected to be about 925,000 bales, 30% more than the 1957–58 stock of 704,000 bales.

Practically all this year's increase was in the extra long-staple types, production of which amounted to 558,000 bales, in contrast to only 165,000 bales in 1957–58. The larger extra long-staple crop resulted from increased plantings – from 514,000 acres in 1957–58 to 637,000 acres this year – and more favourable growing conditions.

The first phase of the irrigated Managil Extension, which included about 67,000 acres of cotton, was completed in time for use in 1958–59. Plans call for an additional 67,000 acres of cotton to be brought into production in each of the next three years as other phases of the extension are completed.

Production of American-type (upland) cotton, mostly rain - grown, amounted to 57,000 bales in 1958–59, up slightly from the 55,000 bales produced last year. The area planted to American type has increased in recent years because of the relatively better demand for upland cotton. This season 252,000 acres were planted to American type, compared with 214,000 last year and 167,000 in 1956–57.

Chile

Wind and heavy rains have damaged crops in South Central Chile and *wheat* loss from lodging adds to earlier frost damage. The 1958–59 crop estimate has been revised downward to 37,015,550 bushels, which may mean a deficit ranging from 7,348,000 bushels to 9,552,400 bushels this year.

Some loss is also expected in *sunflower*, Chile's principal oilseed crop. The appearance of ' oidium ' (mould) is expected to affect the quality and yield of wine and table *grapes*. Late *potato* blight has also spread and is now affecting plantings in one area.

The 1958–59 *lentil* crop is estimated unofficially at 240,000 bags of 100 lb. each, or about 16% below a year ago and 16% below the three-year 1954–57 average. Production in two provinces has been severely damaged by the ' Roya ' disease (a rust), which severely damaged Argentina's lentil crop last year. The loss in these provinces named is as much as 50%, but good yields are expected in other areas.

Argentina

The Argentine *wheat* harvest, now being completed, is reported somewhat larger than last year's crop. The first official estimate places the outturn at 237 million bushels, compared with 213 million a year ago and the 1950–54 average of 216 million bushels.

Wheat yields in most areas are reported to be very satisfactory despite drought during the growing season in some regions. Yields were expected to be lowest in northern Santa Fe, Cordoba and Entre Rios. Acreage seeded to wheat for the current crop was 7% above the sown area for the 1957 crop.

Peru

An expansion of the drought into the northern coastal departments of Peru threatens poor crops, especially of *cotton*, *rice* and *sugar*, for 1959. In some valleys the transplanting of rice and the planting of cotton is being delayed.

Mexico

Mexico's 1958–59 *cotton* crop is currently estimated at 2,200,000 bales (each 500 lb. gross). Although slightly lower than earlier estimates, it is 6% larger than the 2,085,000 bales grown in 1957–58, and second only to the record 1955–56 crop of 2,250,000 bales. This season's larger crop was due to increased plantings, also the second highest on record.

Acreage in 1958–59 amounted to 2,490,000 acres, compared with 2,250,000 acres in 1957-58, 2,095,000 acres in 1956–57, and the record 2,700,000 acres in 1955–56. Acreage in 1959–60 may decline from 1958–59.

The 1958–59 crop is a record in the Matamoros and Mexicali districts, and in the west coast states of Sonora and Sinaloa.

Heavy rains in September and October caused some grade deterioration, especially in the Delicias and Laguna districts. For the country as a whole, the proportion of Middling and better grades this year is believed to be less than 50%, compared with 60 to 70% in a normal season.

Mexico's 1958 *maize* crop is expected to set a record of about 195 million bushels, which would exceed the 1957 crop by 20% and the 1950-54 average by 38%. Acreage was at the high level of the past two years and yields at a new record. Above-normal rainfall since the beginning of May in most districts has contributed to the high yields, though storms and floods during late September and early October caused some losses.

Mexico's *coffee* harvest will be somewhat later than usual this season, and exports are not expected to move in volume before the end of November. Production in Chiapas is said to be smaller this year as a result of storm damage in June. This decline, however, is expected to be more than offset by an increase in Vera Cruz, where weather has been particularly favourable.

Uganda

Uganda plans to go ahead with the *cocoa* development programme it started last year. Cocoa seedlings were planted on 15 acres in eastern Buganda province last spring and it is planned to expand this area to 100 acres in 1959; 300 acres in 1960; 450 acres in 1961; 600 acres in 1962; and 1,000 acres in 1963.

There apparently is considerable land suitable for the growing of cocoa, and it is believed that cocoa would yield 1,500 to 2,000 lb. annually where coffee would yield only 1,000 lb. However, as many of the cocoa plantings will be made on land now in profitable crops, the programme cannot be pushed too fast.

Pakistan

Weather in East Pakistan during the important growing month of November was ideal for aman (winter-crop) *rice*. This crop accounts for about 71% of Pakistan's annual rice production.

The rice acreage in West Pakistan was increased substantially in the 1958–59 season. Weather was generally favourable, so production in that area is larger than in 1957–58.

England and Wales

Conditions were favourable for cultivations during February and good progress was made, except on some heavy soils. Considerable progress was made with spring sowing on the lighter land.

On the whole, autumn-sown *wheat* was satisfactory, although some later sown crops were rather backward and damage due to previous waterlogging was reported from several areas. *Barley*, *oats* and *rye* were generally satisfactory and *beans* made good progress.

Potatoes in store were generally satisfactory, with no serious deterioration, but some sprouting was reported.

Leys, on the whole, were in fairly good condition, except where badly poached. Growth had just commenced in many areas. *Permanent pastures* made little growth and many fields are badly poached.

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